AHRQ

AHRQ QUALITY INDICATORS

Guide to Patient Safety Indicators

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Preface

In health care as in other arenas, that which cannot be measured is difficult to improve. Providers, consumers, policy makers, and others seeking to improve the quality of health care need accessible, reliable indicators of quality that they can use to flag potential problems or successes; follow trends over time; and identify disparities across regions, communities, and providers. As noted in a 2001 Institute of Medicine study, *Envisioning the National Health Care Quality Report*, it is important that such measures cover not just acute care but multiple dimensions of care: staying healthy, getting better, living with illness or disability, and coping with the end of life.

The Agency for Healthcare Research and Quality (AHRQ) Quality Indicators (QIs) are one Agency response to this need for multidimensional, accessible quality indicators. They include a family of measures that providers, policy makers, and researchers can use with inpatient data to identify apparent variations in the quality of inpatient or outpatient care. AHRQ's Evidence-Based Practice Center (EPC) at the University of California and Stanford University adapted, expanded, and refined these indicators based on the original Healthcare Cost and Utilization Project (HCUP) Quality Indicators developed in the early 1990s.

The new AHRQ QIs are organized into three modules, which are being published as a series: **Prevention Quality Indicators**, **Inpatient Quality Indicators**, and **Patient Safety Indicators**. All three modules are available and can be downloaded from AHRQ's Web site at http://www.qualityindicators.ahrq.gov/. The QIs were developed as an accessible and low-cost screening tool to help organizations identify potential problems in quality of care and target promising areas for in-depth review.

This third module focuses on potentially preventable complications and iatrogenic events for patients treated in hospitals. The Patient Safety Indicators (PSIs) are measures that screen for adverse events that patients experience as a result of exposure to the health care system; these events are likely amenable to prevention by changes at the system or provider level. The PSIs include 20 hospital-level and 6 area level indicators.

Full technical information on the first two modules can be found in *Evidence Report for Refinement of the HCUP Quality Indicators*, prepared by the UCSF-Stanford EPC. It can be accessed at AHRQ's Web site. The technical report for the third module, entitled *Evidence Report for Measures of Patient Safety Based on Hospital Administrative Data—The Patient Safety Indicators*, is also available on AHRQ's Web site.

Improving the quality of inpatient hospital services is a critical part of efforts to provide high quality health care in the United States. This guide is intended to facilitate such efforts. As always, we would appreciate hearing from those who use our measures and tools so that we can identify how they are used, how they can be refined, and how we can measure and improve the quality of the tools themselves.

Irene Fraser, Ph.D., Director
Center for Organization and Delivery Studies

The programs for the Patient Safety Indicators (PSIs) can be downloaded from **http://www.qualityindicators.ahrq.gov/**. Instructions on how to use the programs to calculate the PSI rates are contained in the companion text, *Patient Safety Indicators: Software Documentation.*

We welcome your feedback. Support staff are available to answer your questions and respond to comments. They can be reached at **support@qualityindicators.ahrq.gov**.

Acknowledgments

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The following staff from the **Evidence-based Practice Center (EPC) at UCSF-Stanford** performed the evidence review, completed the empirical evaluation, and created the programming code and technical documentation for the new Quality Indicators:

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Introduction to the AHRQ Patient Safety Indicators

Patient safety is an issue of major national interest. Policymakers, providers, and consumers have made the safety of care in U.S. hospitals a top priority. The need to assess, monitor, track, and improve the safety of inpatient care became apparent with publication of the Institute of Medicine's series of reports describing the problem of medical errors[1]. As our health care system becomes more complex, the possibility of significant unintended adverse effects increases.

One approach to detecting, characterizing, and reporting potentially preventable adverse events is to develop screening measures based on routinely collected administrative data. These data can be used to identify indicators of potential problems that result from exposure to the health care system and are likely to be prevented as a result of system-level changes.

Hospital administrative data offer a window into the medical care delivered in our nation's hospitals. These data, which are collected as a routine step in the delivery of hospital services, provide information on patients' diagnoses, procedures, age, gender, admission source, and discharge status. From these data elements, it is possible to construct a picture of the quality—and safety—of medical care. Although assessments based on administrative data cannot be definitive, they can be used to flag potential safety problems and success stories, which can then be further investigated and studied. Hospital associations, individual hospitals, purchasers, regulators, and policymakers at the local, State, and Federal levels can use readily available hospital administrative data to begin the assessment of patient safety.

The Agency for Healthcare Research and Quality (AHRQ) Patient Safety Indicators (PSIs) are a tool that takes advantage of hospital administrative data. The PSIs represent the current state-of-the-art in measuring the safety of hospital care through analysis of inpatient discharge data.

What Are the Patient Safety Indicators?

The PSIs are a set of measures that can be used with hospital inpatient discharge data to provide a perspective on patient safety. Specifically, PSIs screen for problems that patients experience as a result of exposure to the healthcare system and that are likely amenable to prevention by changes at the system or provider level. These are referred to as complications or adverse events. PSIs are defined on two levels: the hospital level and the area level.

- *Hospital-level indicators* provide a measure of the potentially preventable complication for patients who received their initial care and the complication of care within the same hospitalization. Hospital-level indicators include only those cases where a secondary diagnosis code flags a potentially preventable complication.

- *Area-level indicators* capture all cases of the potentially preventable complication that occur in a given area (e.g., metropolitan service area or county) either during hospitalization or result in subsequent hospitalization. Area-level indicators are specified to include principal diagnosis, as well as secondary diagnoses, for the complications of care. This specification adds cases where a patient's risk of the complication occurred in a separate hospitalization.

[1] Institute of Medicine. To Err is Human: Building a Safer Health System. Kohn LT, Corrigan JM, Donaldson MS (eds.) Washington DC: National Academy Press, 2000.

The PSIs include the following hospital-level indicators:

Accidental puncture or laceration	Postoperative pulmonary embolism (PE) or deep vein thrombosis (DVT)
Complications of anesthesia	Postoperative respiratory failure
Death in low-mortality diagnosis-related groups (DRGs)	Postoperative sepsis
Decubitus ulcer	Postoperative wound dehiscence
Failure to rescue	Selected infections due to medical care
Foreign body left during procedure	Transfusion reaction
Iatrogenic pneumothorax	Birth trauma—injury to neonate
Postoperative hemorrhage or hematoma	Obstetric trauma—Cesarean delivery
Postoperative hip fracture	Obstetric trauma—vaginal delivery with instrument
Postoperative physiologic and metabolic derangement	Obstetric trauma—vaginal delivery without instrument

In addition, the following PSIs were modified into area-level indicators to assess the total incidence of the adverse event within geographic areas.

Accidental puncture or laceration
Foreign body left during procedure
Iatrogenic pneumothorax
Selected infections due to medical care
Postoperative wound dehiscence
Transfusion reaction

How Can the PSIs be Used to Assess Patient Safety?

Widespread consensus exists that health care organizations can reduce patient injuries by improving the environment for safety—from implementing technical changes, such as electronic medical record systems, to improving staff awareness of patient safety risks. Clinical process interventions also have strong evidence for reducing the risk of adverse events related to a patient's exposure to hospital care.[2] PSIs, which are based on computerized hospital discharge abstracts from the AHRQ's Healthcare Cost and Utilization Project (HCUP), can be used to better prioritize and evaluate local and national initiatives. Analyses of these and similar inexpensive, readily available administrative data sets may provide a screen for potential medical errors and a method for monitoring trends over time. The scenario on the following page illustrates one potential application of the PSIs.

What Does this Guide Contain?

This guide provides information that hospitals, State data organizations, hospital associations, and others can use to decide how to use the PSIs. First, it describes the origin of the entire family of AHRQ Quality Indicators. Second, it provides an overview of the methods used to identify, select, and evaluate the AHRQ PSIs. Third, the guide summarizes the PSIs specifically, describes strengths and limitations of the indicators, documents the evidence that links the PSIs to the quality of health care services, and then provides in-depth two-page descriptions of each PSI. Finally, two appendices present additional technical background information. Appendix A outlines the specific definitions of each PSI, with complete ICD-9-CM coding specifications. Appendix B provides the details of the empirical methods used to explore the PSIs.

Evaluating and Improving Quality of Care

A hospital association recognizes its member hospitals' need for information that can help them evaluate the quality of care they provide. There is significant interest in assessing, monitoring and improving the safety of inpatient care. After learning about the AHRQ PSIs, the association decides to apply the indicators to the discharge abstract data submitted by individual hospitals. For each hospital, the association develops a report with graphic presentation of the risk-adjusted data to show how the hospital performs on each indicator compared to its peer group, the State as a whole, and other comparable States. National and regional averages from the AHRQ Healthcare Cost and Utilization Project (HCUP) database are also provided as additional external benchmarks. Three years of trend data are included to allow the hospital to examine any changing patterns in its performance.

One member hospital, upon receiving the report, convenes an internal work group comprised of clinicians and quality improvement professionals to review the information and identify potential areas for improvement. The hospital leadership is committed to performance excellence and providing a culture supportive of systems evaluation and redesign. To begin their evaluation, they apply the AHRQ software to their internal administrative data to distinguish those patients who experienced the complication or adverse event from those who did not. This step establishes the focus for chart review.

After the initial analysis of the administrative and clinical data, the work group meets with clinical departments involved in care of these patients. They begin an in-depth analysis of the system and processes of care. Through application of process improvement concepts, they begin to identify opportunities for improvement. After selection of their priority area (for example, reduction of postoperative complications), they begin work, including:

- Review and synthesize the evidence base and best practices from scientific literature.
- Work with the multiple disciplines and departments involved in care of surgical patients to redesign care based on best practices with an emphasis on coordination and collaboration.
- Evaluate information technology solutions.
- Implement performance measurements for improvement and accountability.
- Incorporate monitoring of performance measurements in the departmental and senior leadership meetings and include in the Board quality improvement reports.

Origins and Background of the Quality Indicators

In the early 1990s, in response to requests for assistance from State-level data organizations and hospital associations with inpatient data collection systems, AHRQ developed a set of quality measures that required only the type of information found in routine hospital administrative data—diagnoses and major procedures, along with information on patient's age, gender, source of admission, and discharge status. These States were part of the Healthcare Cost and Utilization Project, an ongoing Federal-State-private sector collaboration to build uniform databases from administrative hospital-based data.

AHRQ developed these measures, called the HCUP Quality Indicators, to take advantage of a readily available data source—administrative data based on hospital claims—and quality measures that had been reported elsewhere.[2] The 33 HCUP QIs included measures for avoidable adverse outcomes, such as in-hospital mortality and complications of procedures; use of specific inpatient procedures thought to be overused, underused, or misused; and ambulatory care sensitive conditions.

Although administrative data cannot provide definitive measures of health care quality, they can be used to provide *indicators* of health care quality that can serve as the starting point for further investigation. The HCUP QIs have been used to assess potential quality-of-care problems and to delineate approaches for dealing with those problems. Hospitals with high rates of poor outcomes on the HCUP QIs have reviewed medical records to verify the presence of those outcomes and to investigate potential quality-of-care problems.[3] For example, one hospital that detected high utilization rates for certain procedures refined patient selection criteria for these procedures to improve appropriate utilization.

Development of the AHRQ Quality Indicators

Since the original development of the HCUP QIs, the knowledge base on quality indicators has increased significantly. Risk adjustment methods have become more readily available, new measures have been developed, and analytic capacity at the State level has expanded considerably. Based on input from current users and advances to the scientific base for specific indicators, AHRQ funded a project to refine and further develop the original QIs. The project was conducted by the UCSF-Stanford EPC.

The major constraint placed on the UCSF-Stanford EPC was that the measures could require only the type of information found in hospital discharge abstract data. Further, the data elements required by the measures had to be available from most inpatient administrative data systems. Some State data systems contain innovative data elements, often based on additional information from the medical record. Despite the value of these record-based data elements, the intent of this project was to create measures that were based on a *common denominator discharge data set*, without the need for additional data collection. This was critical for two reasons. First, this constraint would result in a tool that could be used with any inpatient administrative data, thus making it useful to most data systems. Second, this would enable national and regional benchmark rates to be provided using HCUP data, since these benchmark rates would need to be calculated using the universe of data available from the States.

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[2] Ball JK, Elixhauser A, Johantgen M, et al. *HCUP Quality Indicators, Methods, Version 1.1: Outcome, Utilization, and Access Measures for Quality Improvement*. (AHCPR Publication No. 98-0035). Healthcare Cost and Utilization project (HCUP-3) Research notes: Rockville, MD: Agency for Health Care Policy and Research, 1998.

[3] *Impact: Case Studies Notebook – Documented Impact and Use of AHRQ's Research*. Compiled by Division of Public Affairs, Office of Health Care Information, Agency for Healthcare Research and Quality.

AHRQ Quality Indicator Modules

The work of the UCSF-Stanford EPC resulted in the *AHRQ Quality Indicators*, which are being distributed as three separate modules:

- **Prevention Quality Indicators**. These indicators consist of "ambulatory care sensitive conditions," hospital admissions that evidence suggests could have been avoided through high-quality outpatient care or that reflect conditions that could be less severe, if treated early and appropriately.

- **Inpatient Quality Indicators**. These indicators reflect quality of care inside hospitals and include inpatient mortality; utilization of procedures for which there are questions of overuse, underuse, or misuse; and volume of procedures for which there is evidence that a higher volume of procedures is associated with lower mortality.

- **Patient Safety Indicators**. These indicators focus on potentially preventable instances of complications and other iatrogenic events resulting from exposure to the health care system.

Methods of Identifying, Selecting, and Evaluating the Quality Indicators

Since the literature surrounding PSIs is sparse, the project team used a variety of additional techniques to identify, select, and evaluate each indicator, including clinician panels, expert coders, and empirical analyses.

Step 1: Define the Concepts and the Evaluation Framework

In approaching the task of evaluating patient safety indicators based on administrative data, the project team developed a conceptual framework and standardized definitions of commonly used terms.

Standardized Definitions

In the literature, the distinctions between medical error, adverse events, complications of care, and other terms pertinent to patient safety are not well established and are often used interchangeably. In this report, the terms medical error, adverse events or complications, and similar concepts are defined as follows:

Case finding indicators. Indicators for which the primary purpose is to identify specific cases in which a medical error *may* have occurred, for further investigation.

Complication or adverse event. "An injury caused by medical management rather than by the underlying disease or condition of the patient."[4] In general, adverse events prolong the hospitalization, produce a disability at the time of discharge, or both. Used in this report, complication does not refer to the sequelae of diseases, such as neuropathy as a "complication" of diabetes. Throughout the report, "sequelae" is used to refer to these conditions.

Medical error. "The failure of a planned action to be completed as intended (i.e., error of execution) or the use of a wrong plan to achieve an aim (i.e., error of planning)."[1] The definition includes errors committed by any individual, or set of individuals, working in a health care organization.[5]

Patient safety. "Freedom from accidental injury," or "avoiding injuries or harm to patients from care that is intended to help them." Ensuring patient safety "involves the establishment of operational systems and processes that minimize the likelihood of errors and maximizes the likelihood of intercepting them when they occur." [6]

Patient safety indicators. Specific quality indicators which also reflect the quality of care inside hospitals, but focus on aspects of patient safety. Specifically, PSIs screen for problems that patients experience as a result of exposure to the healthcare system, and that are likely amenable to prevention by changes at the system or provider level.

Preventable adverse event. An adverse event attributable to error is a "preventable adverse event."[7] A condition for which reasonable steps may reduce (but not necessarily eliminate) the

[4] Brennan TA, Leape LL, Laird NM, Hebert L, Localio AR, Lawthers AG, et al. Incidence of adverse events and negligence in hospitalized patients. Results of the Harvard Medical Practice Study I. N Engl J Med 1991;324(6):370-6.

[5] Institute of Medicine, 2000.

[6] Envisioning the National Health Care Quality Report. Washington, DC: Institute of Medicine; 2001.

[7] Brennan et al., 1991.

risk of that complication occurring.

Quality. "Quality of care is the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge." In this definition, "the term *health services* refers to a wide array of services that affect health…(and) applies to many types of health care practitioners (physicians, nurses, and various other health professionals) and to all settings of care…"[8]

Quality indicators. Screening tools for the purpose of identifying potential areas of concern regarding the quality of clinical care. For the purpose of this report, we focus on indicators that reflect the quality of care inside hospitals. Quality indicators may assess any of the four system components of health care quality, including patient safety (see below), effectiveness (i.e., "providing services based on scientific knowledge to all who could benefit, and refraining from providing services to those not likely to benefit), patient centeredness, and timeliness (i.e., "minimizing unnecessary delays").[9]

Rate based indicators. Indicators for which the primary purpose is to identify the rate of a complication rather than to identify specific cases.

While the definitions above are intended to distinguish events that are less preventable from those that are more preventable, the difference is best described as a spectrum. To conceptualize this spectrum, the project team developed the following three categories of conditions:

1. Conditions that could be either a comorbidity or a complication. Conditions considered comorbidities (for example, congestive heart failure) are present on admission and are not caused by medical management; rather, they are due to the patient's underlying disease. It is extremely difficult to distinguish complications from comorbidities for these conditions using administrative data. As a result, these conditions were not considered in this report.

2. Conditions that are likely to reflect medical error. These conditions (for example, foreign body accidentally left during a procedure) are likely to have been caused by medical error. Most of these conditions appear infrequently in administrative data, and thus rates of events lack the precision to allow for comparisons between providers. However, these conditions may be the subject of case-finding indicators.

3. Conditions that conceivably, but not definitively reflect medical error. These conditions (for example, postoperative DVT or PE) represent a spectrum of preventability between the previous two categories—from those that are mostly unpreventable to those that are mostly preventable. Because of the uncertainty regarding the preventability of these conditions and the likely heterogeneity of cases with the condition, indicators using these conditions are less useful as case-finding indicators. However, examining the rate of these conditions may highlight potential areas of concern.

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[8] Measuring the Quality of Health Care: A statement of the National Roundtable on Healthcare Quality Division of Healthcare Services: National Academy Press; 1999.

[9] National Roundtable on Healthcare Quality, 1999.

Evaluation Framework

To evaluate the soundness of each indicator, the project team applied the same framework as was applied in the technical report[10] for the Prevention Quality Indicators (PQIs) and Inpatient Quality Indicators (IQIs). This included six areas of evidence:

- **Face validity.** Does the indicator capture an aspect of quality that is widely regarded as important and subject to provider or public health system control? Consensual validity expands face validity beyond one person to the opinion of a panel of experts.

- **Precision.** Is there a substantial amount of provider- or community-level variation that is not attributable to random variation?

- **Minimum bias.** Is there either little effect on the indicator of variations in patient disease severity and comorbidities, or is it possible to apply risk adjustment and statistical methods to remove most or all bias?

- **Construct validity.** Does the indicator perform well in identifying true (or actual) quality of care problems?

- **Fosters real quality improvement.** Is the indicator insulated from perverse incentives for providers to improve their reported performance by avoiding difficult or complex cases, or by other responses that do not improve quality of care?

- **Application.** Has the measure been used effectively in practice? Does it have potential for working well with other indicators?

Face validity (consensual validity) was evaluated using a structured panel review, minimum bias was explored empirically and briefly during the panel review, and construct validity was evaluated using the limited literature available. A full discussion of this framework is available in the Stanford Technical report.[11]

The relative importance of each of these evaluation areas may differ by individual PSIs.. Precision and minimum bias may be less important for indicators that are primarily designed to screen only for medical error, since these events are relatively rare. In general, these indicators are better used as case-finding indicators. For these indicators, comparisons between rates are less relevant. However, for rate-based indicators, concerns of precision and minimum bias remain if indicators are used in any comparison of rates (comparison to national averages, peer group, etc.).

Step 2: Search the Literature to Identify Potential PSIs

The literature searches performed in connection with assessing potential AHRQ QIs[12] identified many references relevant to potential PSIs. In addition, the project team performed electronic searches for articles published before February 2002 followed by hand searching the bibliographies of identified references. Members of the project team were queried to supplement this list, based on their personal

[10] Davies S, Geppert J, McClellan M, McDonald KM, Romano PS, Shojania KG. Refinement of the HCUP Quality Indicators. Technical Review Number 4. Rockville, MD: (Prepared by UCSF-Stanford Evidence-based Practice Center under Contract No. 290-97-0013) Agency for Healthcare Research and Quality; 2001. Report No.: 01-0035.

[11] Davies et al., 2001.

[12] Davies et al., 2001.

knowledge of recent work in the field. Because Iezzoni et al.'s Complications Screening Program (CSP)[13] included numerous candidate indicators, the team also performed an author search using her name. Forthcoming articles and Federal reports in press, but not published, were also included when identified through personal contacts.

The project team identified 326 articles from the Medline search. Articles were screened using both the titles and abstracts. To qualify for abstraction, an article must have described, evaluated, or validated a potential indicator of medical errors, patient safety, or potentially preventable complications based on International Classification for Diseases - Ninth Revision - Clinical Modifications (ICD-9-CM) coded administrative (hospital discharge or claims) data. Some indicators were also considered if they appeared to be readily translated into ICD-9-CM, even if the original authors did not use ICD-9-CM codes.

This search was adapted slightly and repeated using the OVID interface with EMBASE[14], limited to articles published from January 1990 through the end of first quarter 2002. The EMBASE search identified 463 references, and these articles were screened in the same manner. After elimination of articles that had already been identified using Medline[15] and the other approaches described above, only nine additional articles met the criteria for abstraction.

Step 3: Develop a Candidate List of PSIs

The project team developed a candidate list of PSIs by first reviewing the literature, then selecting a subset of indicators to undergo face validity testing by clinician panels.

Candidate List of PSIs

The literature search located relatively few patient safety indicators that could be defined using unlinked administrative data. The majority of these indicators were from the Complications Screening Program (CSP),[16] which was developed to identify potentially preventable complications of adult medical and surgical hospital care using commonly available administrative data. The algorithm uses discharge abstract data—specifically ICD-9-CM diagnosis and procedure codes, patient age, sex, diagnosis-related group (DRG), and date of procedure—to identify 28 complications that raise concern about the quality of care based on the rate of such occurrences at individual hospitals. Each of the complications is applied to some or all of the following specified "risk pools" separately: major surgery, minor surgery, invasive cardiac procedure, endoscopy, medical patients, and all patients. In addition, specified inclusion and exclusion criteria are applied to each complication to ensure that the complication developed in-hospital, as opposed to being present on admission, and that the complication was potentially preventable.

Four later studies were designed to test criterion and construct validity by validating the data used to construct CSP screens, validating the screens as a flag for actual quality problems, and validating the replicability of hospital-level results using different data sources.[17] [18] [19] [20] These studies raised concerns

[13] Iezzoni LI, Foley SM, Heeren T, Daley J, Duncan CC, Fisher ES, et al. A method for screening the quality of hospital care using administrative data: preliminary validation results. QRB Qual Rev Bull 1992;18(11):361-71.

[14] EMBASE. In. The Netherlands: Elsevier Science Publishers B.V.

[15] MEDLINE [database online]. In. Bethesda (MD): National Library of Medicine.

[16] Iezzoni et al., 1992.

[17] Lawthers A, McCarthy E, Davis R, Peterson L, Palmer R, Iezzoni L. Identification of in-hospital complications from claims data: is it valid? Medical Care 2000;38(8):785-795.

[18] McCarthy EP, Iezzoni LI, Davis RB, Palmer RH, Cahalane M, Hamael MB, et al. Does clinical evidence support

about the validity of the CSP, because flagged cases for most indicators were no more likely than unflagged controls to have suffered explicit process failures.

The project team also reviewed all ICD-9-CM codes implemented in or before 1999 that were identified by AHRQ as possibly describing medical errors or reflecting the consequences of such errors.[21] (This initial set of indicators is referred to as the Miller et al. indicators.) The project team added relevant codes from the 2000 and 2001 revisions of ICD-9-CM and selected codes from the CSP, such as those not clearly reflective of medical error, but representing a potentially preventable complication. This process was guided principally by conceptual considerations. For example, codes for postoperative AMI (an evaluated indicator that was not included in the final indicator set) were included in the evaluation set since recent evidence suggests that AMI is a potentially preventable complication.[22] A few codes were also deleted from the initial list based on a review of ICD-9-CM coding guidelines, described in *Coding Clinics for ICD-9-CM* and the *American Hospital Association's ICD-9-CM Coding Handbook*. For example, the code 2593 for hypoglycemic coma specifically excludes patients with diabetes mellitus, the population for which this complication is most preventable. This process of updating the Miller et al. PSIs resulted in a list of over 200 ICD-9-CM codes (valid in 2001) potentially related to medical error.

Codes identified in the CSP and updated from the Miller et. al. PSIs were then grouped into indicators. Where feasible, codes were compiled as they were in the CSP, or in some cases the Miller et al. PSIs, depending on which grouping yielded more clinically homogeneous groups. In most cases the resulting indicators were not identical to the CSP indicators, although they were closely related, as some of the specific codes included in the original CSP had been eliminated after the team's review of coding guidelines. The remaining codes were then incorporated into the most appropriate CSP-based indicator, or were grouped into clinically meaningful concepts to define novel indicators. Exclusion criteria were added based on CSP methods and clinical judgment. As a result, over 40 patient safety indicators were defined that, while building on prior work, reflected significantly changed measures to focus more narrowly on the most preventable complications.

Indicators were defined with both a numerator (complication of interest) and a denominator (population at risk). Different patient subpopulations have inherently different risks for developing a complication, with some patients having almost no risk. Thus, the denominator for each indicator represents the specific population at risk. The intention was to restrict the complication (and consequently the rate) to a more homogeneous population who are actually at risk for that complication. In general, the population at risk corresponded to one risk pool (e.g., major surgery) from the CSP, if applicable, or was defined more narrowly.

Subset Selection

After the project team developed a list of potential indicators, they selected a subset of indicators

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ICD-9-CM diagnosis coding of complications? Med Care 2000;38(8);868-876.

[19] Weingart SN, Iezzoni LI, Davis RB, Palmer RH, Cahalane M, Hamel MB, et al. Use of administrative data to find substandard care: validation of th complications screening program Med Care 2000;38(8):796-806.

[20] Iezzoni LI, Davis RB, Palmer RH, Cahalane M, Hamel MB, Mukamal K, et al. Does the Complications Screening Program flag cases with process of care problems? Using explicit criteria to judge processes. Int J Qual Health Care 1999;11(2):107-18.

[21] Miller M, Elixhauser A, Zhan C, Meyer G. Patient Safety Indicators: Using administrative data to identify potential patient safety concerns. Health Services Research 2001;36(6 Part II):110-132.

[22] Shojania KG, Duncan BW, MdDonald KM, Wachter RM. Making health care safer: A critical analysis of patient safety practices. Evidence Report/Technology Assessment No. 43 (Prepared by the University of California at San Francisco-Stanford Evidence-based Practice Center under Contract No. 290-97-0013). Rockville, MD: Agency for Healthcare Research and Quality; 2001. Report No.: AHRQ Publication No. 01-E058.

to undergo face validity testing by clinician panels, as described in Step 4. Two sources of information guided the selection process.

First, validation data from previous studies were reviewed and thresholds were set for retaining CSP-based indicators. Four studies were identified that evaluated the CSP indicators. Three of these studies, examined the predictive value of each indicator in identifying a complication that occurred in-hospital, regardless of whether this complication was due to medical error or was preventable. [23] [24] [25] In a fourth study, nurses identified specific process failures that may have contributed to complications. In order to be retained as a potential PSI, at least one of the first three studies needed to demonstrate a positive predictive value of at least 75%, meaning that 3 out of 4 patients identified by the measure did indeed have the complication of interest.[26] In addition, the positive predictive value of a "process failure" identified in the fourth study needed to reach or exceed 46%, which was the average rate for surgical cases that were not flagged by any of the CSP indicators. As a result, only CSP-derived indicators that were at least somewhat predictive of objectively defined process failures or medical errors were retained.

Second, specific changes to previous definitions or constructs of indicators fell into the following general categories:

1. Changes to the denominator definitions (inclusion or exclusion criteria), intended to reduce bias due to the inclusion of atypical patients or to improve generalizability to a broader set of patients at risk.

2. Elimination of selected ICD-9-CM codes from numerator definitions, intended to focus attention on more clinically significant complications or complications more likely to result from medical errors.

3. Addition of selected ICD-9-CM codes to numerator definitions, intended to capture related complications that could result from the same or similar medical errors.

4. Division of a single indicator into two or more related indicators, intended to create more clinically meaningful and conceptually coherent indicators.

5. Stratification or adjustment by relevant patient characteristics, intended to reflect fundamental clinical differences among procedures (e.g., vaginal delivery with or without instrumentation) and the complications that result from them, or fundamental differences in patient risk (e.g., decubitus ulcer in lower-risk versus high-risk patients).

A total of 34 indicators, intended to be applied to all age groups, were retained for face validity testing by clinician panels. Because the primary intent in developing these indicators was to detect potentially preventable complications related to health care exposure, the final definitions for this set of indicators represented mostly new measures that built upon previous work.

Coding Review

Experts in ICD-9-CM codes reviewed each code for accuracy of capturing the complication and population at risk. In some cases, additional codes or other refinements to the indicators were suggested based on current coding guidelines.

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[23] Lawthers, et al., 2000.

[24] McCarthy, et al., 2000.

[25] Weingart et al., 2000.

[26] Iezzoni et al., 1999.

Step 4: Review the PSIs

The project team conducted a structured review of each indicator to evaluate the face validity (from a clinical perspective) of the indicators. The methodology for the structured review was adapted from the RAND/UCLA Appropriateness Method[27] and consisted of an initial independent assessment of each indicator by clinician panelists using an initial questionnaire, a conference call among all panelists, followed by a final independent assessment by clinician panelists using the same questionnaire. The review sought to establish *consensual validity,* which "extends face validity from one expert to a panel of experts who examine and rate the appropriateness of each item…."[28] The panel process served to refine definitions of some indicators, add new measures, and dismiss indicators with major concerns from further consideration.

Eight panels were formed: two panels examined complications of medical care indicators, three panels examined surgical complications indicators, one panel assessed indicators related to procedural complications, and two panels examined obstetric complications indicators.

Fifteen professional clinical organizations nominated a total of 162 clinicians to be panelists. To be eligible to participate, nominees were required to spend at least 30% of their work time on patient care, including hospitalized patients. Nominees were asked to provide information regarding their practice characteristics, including specialty, subspecialty, and setting. Fifty-seven panelists were selected to ensure that each panel had diverse membership in terms of practice characteristics and setting.

Initial Assessment of the Indicators

Panelists were presented with four or five indicators, including the standardized text used to describe each ICD-9-CM code, the specific numeric code, exclusion and inclusion criteria, the clinical rationale for the indicator, and the specification criteria. For each indicator, panelists completed a 10-item questionnaire that evaluated the ability of the indicator to screen out conditions present on admission, the potential preventability of the complication, and the ability of the indicator to identify medical error. In addition, the questionnaire asked panelists to consider potential bias, reporting or charting problems, potential for gaming the indicator, and adverse effects of implementing the indicator. Finally, the questionnaire provided an opportunity for panelists to suggest changes to the indicator.

Conference Call Participation

After the panelists submitted the initial evaluation questionnaires, they participated in a 90-minute conference call for their panel to discuss the indicators. In general, agenda items for the conference call focused on points of disagreement among panelists. However, panelists were explicitly told that consensus was not the goal of discussion. In some cases, panelists agreed on proposed changes to the indicator definitions, and such consensus was noted and the definition was modified accordingly before the final round of rating.

Panelists were prompted throughout the process to consider the appropriate population at risk for each indicator (specifically inclusion and exclusion criteria) in addition to the complication of interest. However, if panelists wished to discuss other aspects of the indicator, this discussion was allowed within the time allotted for that indicator (approximately 15 minutes). If time remained at the end of a call, topics that were not fully addressed previously were revisited.

Final Evaluation and Tabulation of Results

[27] Fitch K, Bernstein J, Aguilar MD, Burnand B, LaCalle JR, Lazaro P, et al. the RAND/UCLA Appropriateness Method User's Manual: RAND; 2001.

[28] Green L, Lewis F. measurement and Evaluation in Health Education and Health Promotion. Mountain View, CA: Mayfield Publishing Company; 1998.

Following each conference call, the project team made changes to each indicator suggested by panelists for changes that reached near consensus of the panelists. The indicators were then redistributed to panelists with the questionnaires used in the initial evaluation. The reason for all each indicator definition change was included, and panelists were asked to re-rate the indicator based on their current opinion. They were asked to keep in mind the discussion during the conference call.

Results from the final evaluation questionnaire were used to calculate median scores from the 9-point scale for each question and to categorize the degree of agreement among panelists. Median scores determined the level of acceptability of the indicator, and dispersion of ratings across the panel for each applicable question determined the agreement status. Therefore the median and agreement status were independent measurements for each question. Six criteria were used to identify the panel opinions (i.e., median, agreement status category) on the following aspects of the indicator:

1. Overall usefulness of the indicator.
2. Likelihood that the indicator measures a complication and not a comorbidity (specifically, present on admission).
3. Preventability of the complication.
4. Extent to which the complication is due to medical error.
5. Likelihood that the complication is charted given that it occurs.
6. Extent that the indicator is subject to bias (systematic differences, such as case mix that could affect the indicator, in a way not related to quality of care).

The project team used the ratings of the overall appropriateness of each indicator to assess its overall usefulness as a screen for potential patient safety problems. Indicators were triaged into three sets: Accepted Indicators (described in this guide), Experimental Indicators, and Rejected Indicators.

Step 5: Evaluate the PSIs Using Empirical Analysis

The project team conducted empirical analyses to explore the frequency and variation of the indicators, the potential bias, based on limited risk adjustment, and the relationship between indicators. The data sources used in the empirical analyses were the 1997 Florida State Inpatient Database (SID) for initial testing and development and the 1997 HCUP State Inpatient Database for 19 States (referred to in this guide as the HCUP SID) for the final empirical analyses. The rates presented in the Detailed Evidence Section of this guide, as well as the means and parameter reference files used by the PSI software, reflect analyses of the 2000 HCUP SID for 29 states.

All potential indicators were examined empirically by developing and conducting statistical tests for precision, bias, and relatedness of indicators. Three different estimates of hospital performance were calculated for each indicator:

1. The raw indicator rate was calculated using the number of adverse events in the numerator divided by the number of discharges in the population at risk by hospital.

2. The raw indicator was adjusted to account for differences among hospitals in age, gender, modified DRG, and comorbidities.

    - Adjacent DRG categories that were separated by the presence or absence of comorbidities or complications were collapsed to avoid adjusting for the complication being measured. Most of the super-Major Diagnostic Category (MDC) DRG categories were excluded for the same reason.

    - APR-DRG risk adjustment was not implemented because removing applicable complications from each indicator was beyond the scope of this project.

    - The ICD-9-CM codes used to define comorbidity categories were modified to exclude conditions likely to represent potentially preventable complications in certain settings.

- "Acute on chronic" comorbidities were captured so that some patients with especially severe comorbidities would not be mislabeled as not having conditions of interest.

- Comorbidities in obstetric patients were added.

3. Multivariate signal extraction methods were applied to adjust for reliability by estimating the amount of "noise" (i.e., variation due to random error) relative to the amount of "signal" (i.e., systematic variation in hospital performance or reliability) for each indicator.

Similar reliability adjustment has been used in the literature for similar purposes.[29] [30] The project team constructed a set of statistical tests to examine precision, bias, and relatedness of indicators for all accepted hospital-level indicators, and precision and bias for all accepted area-level indicators. It should be noted that rates based on fewer than 30 cases in the numerator or the denominator are not reported. This exclusion rule serves two purposes:

1. It eliminates unstable estimates based on too few cases.
2. It helps protect the identities of hospitals and patients.

A detailed description of the methodology is included in Appendix B.

[29] Hofer TP, Hayward RA, Greenfield S, Wagner EH, Kaplan SH, Manning WG. The unreliability of individual physician "report cards" for assessing the costs and quality of care of a chronic disease JAMA 1999;281(22):2098-105.

[30] Christiansen CL, Morris CN. Improving the statistical approach to health care provider profiling. Ann Intern Med 1997;127(8 Pt 2):764-8.

Summary Evidence on the Patient Safety Indicators

This project took a four-pronged approach to the identification, development, and evaluation of PSIs that included use of literature, clinician panels, expert coders, and empirical analyses. The literature review and the findings from the clinical panels combined with data analysis provide evidence to suggest that a number of discharge-based PSIs may be useful screens for organizations, purchasers, and policymakers to identify safety problems at the hospital level, as well as to document systematic area-level differences in patient safety problems.

Most adverse events identified by the PSIs have a variety of causes in addition to potential medical error leading to the adverse event, including underlying patient health and factors that do not vary systematically. Clinician panelists rated only two of the accepted indicators as very likely to reflect medical error: (1) transfusion reaction and (2) foreign body left in during a procedure. These indicators proved to be very rare, with less than 1 per 10,000 cases at risk.

Table 1 summarizes the results of the literature review, clinician panels, and empirical analyses on the hospital-level PSIs. The table lists each indicator, provides its definition, identifies any concerns about its validity based on the clinician panels, and summarizes the strength of evidence in the literature for each indicator.

The following notes about some of the terms in the table are intended to help the reader understand the context in which they are used.

Validity Concerns. The following concerns, raised during our panel review, are listed if they affect the validity of the particular indicator:

- **Rare** — This indicator is relatively rare and may not have adequate statistical power for some providers.
- **Condition definition varies** — This indicator includes conditions for which diagnosis may be subjective, depending on the threshold of the physician, and patients with the same clinical state may not have the same diagnosis.
- **Underreporting or screening** — Conditions included in this indicator may not be systematically reported (leading to an artificially low rate) or may be routinely screened for (leading to a higher rate in facilities that screen).
- **Adverse consequences** — Use of this indicator may have undesirable effects, such as increasing inappropriate antibiotic use.
- **Stratification suggested** — This indicator includes some high risk patient groups and stratification is recommended when examining rates,
- **Unclear preventability** — As compared to other PSIs, the conditions included in this indicator may be less preventable by the health system.
- **Heterogeneous severity** — This indicator includes codes that encompass several levels of severity of a condition that cannot be ascertained by the codes.
- **Case mix bias** — This indicator was felt to be particularly subject to systematic bias, and DRG and comorbidity risk adjustment may not adequately address the concern.
- **Denominator unspecific** — The denominator for this indicator is less than ideal, because the true population at risk could not be identified using ICD-9-CM codes. Some patients are likely included who are not truly at risk, or some patients who are at risk are not included.

Empirical Performance. The performance of each indicator is measured for the following:

- **Rate** — The rate measures the number of adverse events per 1,000 population at risk. Rates represent the average rate of the indicator for a nationwide sample of hospitals.
- **Deviation** — Standard deviation is an estimate of systematic variation. For the PSIs, standard deviation is reported between providers.
- **Bias** — Bias represents the degree to which the results may be influenced by outside factors. Bias

ratings are based on a series of tests of bias using DRG and comorbidity risk adjustment. Those indicators flagged with **X+** demonstrated substantial bias and should be risk adjusted. Those indicators flagged with **X** also demonstrated some bias. Those without a flag did not demonstrate substantial bias in empirical tests, but may nonetheless be substantially biased in a manner not detectable by the bias tests. Those marked with **N/A** did not undergo empirical testing of bias due to lack of systematic variation.

Strength of Evidence. The following key findings represent a review of the limited literature assessing the validity of the indicators:

Coding — Sensitivity is the proportion of patients who suffered an adverse event, based on detailed chart review or prospective data collection, for whom that event was coded on a discharge abstract or Medicare claim. Predictive value is the proportion of patients with a coded adverse event who were confirmed as having suffered that event, based on detailed chart review or prospective data collection.

Construct, explicit process — Adherence to specific, evidence-based or expert-endorsed processes of care, such as appropriate use of diagnostic modalities and effective therapies. The construct is that hospitals that provide better processes of care should experience fewer adverse events.

Construct, implicit process — Adherence to the "standard of care" for similar patients, based on global assessment of quality by physician chart reviewers. The construct is that hospitals that provide better overall care should experience fewer adverse events.

Construct, staffing — The construct is that hospitals that offer more nursing hours per patient day, better nursing skill mix, better physician skill mix, or more experienced physicians should have fewer adverse events.

– Published evidence suggests that the indicator lacks validity in this domain (i.e., less than 50% sensitivity or predictive value; explicit or implicit process failure rates no more frequent than among control patients).

The following distinctions were used to summarize the strength of the published evidence for each indicator:

0 No published evidence regarding this domain of validity.

± Published evidence suggests that the indicator may be valid in this domain, but different studies offer conflicting results (although study quality may account for these conflicts).

+ Published evidence suggests that the indicator is valid, or is likely to be valid, in this domain (i.e., one favorable study).

++ There is strong evidence supporting the validity of this indicator in this domain (i.e., multiple studies with consistent results, or studies showing both high sensitivity and high predictive value). When content validity is exceptionally high, as for transfusion reaction or iatrogenic pneumothorax, construct validity becomes less important.

A complete description of each PSI is included later in the guide under "Detailed Evidence for Patient Safety Indicators" and in Appendix A. Details on the empirical methods can be found in Appendix B.

Table 1. AHRQ Hospital-Level Patient Safety Indicators

	Definition	Validity Concerns	Empirical Performance	Strength of Evidence
Complications of anesthesia	Cases of anesthetic overdose, reaction, or endotrachial tube misplacement per 1,000 surgery discharges. Excludes codes for drug use and self-inflicted injury.	Condition definition varies Underreporting or screening Denominator unspecific	Rate = 0.60 Deviation = 1.72 Bias = Not detected [c]	0 Coding 0 Explicit Process 0 Implicit Process 0 Staffing
Death in low mortality DRGs	In-hospital deaths per 1,000 patients in DRGs with less than 0.5% mortality.[a] Excludes trauma, immunocompromised, and cancer patients.	Heterogeneous severity	Rate = 2.44 Deviation = 30.6 Bias = X+	+ Coding 0 Explicit Process + Implicit Process 0 Staffing
Decubitus ulcer	Cases of decubitus ulcer per 1,000 discharges with a length of stay of 5 or more days. Excludes patients with paralysis or in MDC 9, obstetrical patients in MDC 14, and patients admitted from a long-term care facility.	Underreporting or screening Heterogeneous severity Case mix bias	Rate = 23.9 Deviation = 21.6 Bias = X+	– Coding 0 Explicit Process 0 Implicit Process ± Staffing
Failure to rescue	Deaths per 1,000 patients having developed specified complications of care during hospitalization. Excludes patients age 75 and older, neonates in MDC 15, patients admitted from long-term care facility and patients transferred to or from other acute care facility.	Adverse consequences Stratification suggested Unclear preventability Heterogeneous severity	Rate = 129.4 Deviation = 87.1 Bias = X+	+ Coding 0 Explicit Process 0 Implicit Process ++ Staffing
Foreign body left during procedure	Discharges with foreign body accidentally left in during procedure per 1,000 discharges	Rare Stratification suggested Denominator unspecific	Rate = 0.07 Deviation = 0.17 Bias = N/A	0 Coding 0 Explicit Process 0 Implicit Process 0 Staffing
Iatrogenic pneumothorax	Cases of iatrogenic pneumothorax per 1,000 discharges. Excludes trauma, thoracic surgery, lung or pleural biopsy, or cardiac surgery patients, and obstetrical patients in MDC 14.	Denominator unspecific	Rate = 0.63 Deviation = 0.71 Bias = X	0 Coding 0 Explicit Process 0 Implicit Process 0 Staffing

	Definition	Validity Concerns	Empirical Performance	Strength of Evidence
Selected infections due to medical care	Cases of secondary ICD-9-CM codes 9993 or 00662 per 1,000 discharges. Excludes patients with immunocompromised state or cancer.	Underreporting or screening Adverse consequences	Rate = 1.50 Deviation = 3.30 Bias = X	0 Coding 0 Explicit Process 0 Implicit Process 0 Staffing
Postoperative hemorrhage or hematoma	Cases of hematoma or hemorrhage requiring a procedure per 1,000 surgical discharges. Excludes obstetrical patients in MDC 14.	Stratification suggested Case mix bias Denominator unspecific	Rate = 1.26 Deviation = 2.11 Bias = Not detected	± Coding ± Explicit Process + Implicit Process 0 Staffing
Postoperative hip fracture	Cases of in-hospital hip fracture per 1,000 surgical discharges. Excludes patients in MDC 8, with conditions suggesting fracture present on admission and obstetrical patients in MDC 14.	Case mix bias Denominator unspecific	Rate = 1.33 Deviation = 5.98 Bias = X	+ Coding + Explicit Process + Implicit Process 0 Staffing
Postoperative physiologic and metabolic derangement	Cases of specified physiological or metabolic derangement per 1,000 elective surgical discharges. Excludes patients with principal diagnosis of diabetes and with diagnoses suggesting increased susceptibility to derangement. Excludes obstetric admissions.	Condition definition varies	Rate = 0.78 Deviation = 10.3 Bias = X	– Coding 0 Explicit Process 0 Implicit Process – Staffing
Postoperative PE or DVT	Cases of deep vein thrombosis or pulmonary embolism per 1,000 surgical discharges. Excludes obstetric patients.	Underreporting or screening Stratification suggested	Rate = 9.30 Deviation = 32.8 Bias = X+	+ Coding + Explicit Process + Implicit Process ± Staffing
Postoperative respiratory failure	Cases of acute respiratory failure per 1,000 elective surgical discharges. Excludes MDC 4 and 5 and obstetric admissions.	Unclear preventability Case mix bias	Rate = 3.47 Deviation = 12.1 Bias = X+	+ Coding ± Explicit Process + Implicit Process ± Staffing
Postoperative sepsis	Cases of sepsis per 1,000 elective surgery patients, with length of stay more than 3 days. Excludes principal diagnosis of infection, or any diagnosis of immunocompromised state or cancer, and obstetric admissions.	Condition definition varies Adverse consequences	Rate = 11.8 Deviation = 39.8 Bias = X+	± Coding 0 Explicit Process 0 Implicit Process – Staffing

	Definition	Validity Concerns	Empirical Performance	Strength of Evidence
Postoperative wound dehiscence	Cases of reclosure of postoperative disruption of abdominal wall per 1,000 cases of abdominopelvic surgery. Excludes obstetric admissions.	Case mix bias	Rate = 1.95 Deviation = 4.90 Bias = X	0 Coding 0 Explicit Process 0 Implicit Process 0 Staffing
Accidental puncture or laceration	Cases of technical difficulty (e.g., accidental cut or laceration during procedure) per 1,000 discharges. Excludes obstetric admissions.	Underreporting or screening Unclear preventability	Rate = 2.45 Deviation = 2.58 Bias = X+	± Coding 0 Explicit Process 0 Implicit Process 0 Staffing
Transfusion reaction	Cases of transfusion reaction per 1,000 discharges.	Rare Stratification suggested	Rate = 0.005 Deviation = 0.106 Bias = N/A	0 Coding 0 Explicit Process 0 Implicit Process 0 Staffing
Birth trauma—injury to neonate	Cases of birth trauma per 1,000 liveborn births. Excludes some preterm infants and infants with osteogenic imperfecta.	Condition definition varies Unclear preventability Heterogeneous severity	Rate = 5.61 Deviation = 19.9 Bias = N/A	– Coding 0 Explicit Process 0 Implicit Process 0 Staffing
Obstetric trauma—Cesarean delivery	Cases of obstetric trauma (4th degree lacerations, other obstetric lacerations) per 1,000 Cesarean deliveries.	Unclear preventability Case mix bias	Rate = 5.60 Deviation = 9.99 Bias = N/A	+ Coding 0 Explicit Process 0 Implicit Process 0 Staffing
Obstetric trauma—vaginal delivery with instrument	Cases of obstetric trauma (4th degree lacerations, other obstetric lacerations) per 1,000 instrument-assisted vaginal deliveries.	Unclear preventability Case mix bias	Rate = 218.6 Deviation = 167.1 Bias = N/A	+ Coding 0 Explicit Process 0 Implicit Process 0 Staffing
Obstetric trauma—vaginal delivery without instrument	Cases of obstetric trauma (4th degree lacerations, other obstetric lacerations) per 1,000 vaginal deliveries without instrument assistance.	Unclear preventability Case mix bias	Rate = 80.8 Deviation = 58.4 Bias = N/A	+ Coding 0 Explicit Process 0 Implicit Process 0 Staffing

[a] DRGs that are divided into “with complications and comorbidities” and “without complications and comorbidities” are only included if both divisions have mortality rates below 0.5%.

Limitations in Using the PSIs

Many important concerns cannot currently be monitored well using administrative data, such as adverse drug events, and using these data tends to favor specific types of indicators. For example, the PSIs evaluated in this report contain a large proportion of surgical indicators, rather than medical or psychiatric, because medical complications are often difficult to distinguish from comorbidities that are present on admission. In addition, medical populations tend to be more heterogeneous than surgical, especially elective surgical populations, making it difficult to account for case-mix. Panelists often expressed that indicators were more applicable to patient safety when limited to elective surgical admissions. However, the careful use of administrative data holds promise for screening to target further

data collection and analysis. The ability to assess all patients at risk for a particular patient safety problem, along with the relative low cost, are particular strengths of these data sets.

Two broad areas of concern also hold true for these data sets.

1. Questions about the clinical accuracy of discharge-based diagnosis coding lead to concerns about the interpretation of reported diagnoses that may represent safety problems. Specifically:

   - Administrative data are unlikely to capture all cases of a complication, regardless of the preventability, without false positives and false negatives (sensitivity and specificity).

   - When the codes are accurate in defining an event, the clinical vagueness inherent in the description of the code itself (e.g., "hypotension"), may lead to a highly heterogeneous pool of clinical states represented by that code.

   - Incomplete reporting is an issue in the accuracy of any data source used for identifying patient safety problems, as medical providers might fear adverse consequences as a result of "full disclosure" in potentially public records such as discharge abstracts.

2. The information about the ability of these data to distinguish adverse events in which no error occurred from true medical errors is limited. A number of factors—such as the heterogeneity of clinical conditions included in some codes, lack of information about event timing available in these data sets, and limited clinical detail for risk adjustment—contribute to the difficulty in identifying complications that represent medical error or may be at least in some part preventable.

These factors may exist for other sources of patient safety data as well. For example, they have been raised in the context of the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) implementation of a "sentinel event" program geared at identifying serious adverse events that may be related to underlying safety problems.

Further Research on PSIs

The initial validation evaluations reviewed and performed for the PSIs leave substantial room for further research with detailed chart data and other data sources. Future validation work should focus on the following:

- The sensitivity and specificity of these indicators in detecting the occurrence of a complication.
- The extent to which failures in processes of care at the system or individual level are detected using these indicators.
- The relationship of these indicators with other measures of quality, such as mortality.
- Further explorations of bias and risk adjustment.

Enhancements to administrative data are worth exploring in the context of further validation studies that use data from other sources. For example, as with other quality indicators, the addition of timing variables may prove particularly useful in identifying whether a complication was present on admission, or whether it occurred during the hospitalization. While some of the complications that are present on admission may indeed reflect adverse events of care in a previous hospitalization or outpatient care, many may reflect comorbidities instead of complications. A second example area—linking hospital data over time and with outpatient data and other hospitalizations—would allow inclusion of complications that occur after discharge and likely would increase the sensitivity of the PSIs.

Use of External Cause-of-Injury Codes

Several of the PSIs are based on capturing external cause-of-injury (e-code) data. These codes are used to classify environmental events, circumstances, and conditions as the cause of injury, poisoning, or other adverse events. External cause-of-injury codes are critical to evaluate population-based, cause-specific data on nonfatal injuries at the state and local levels. However, not all states collect this information in their hospital discharge data programs nor do all state uniform billing committees require use of e-codes. Users of the PSIs should be knowledgeable of the e-code requirements and practices of hospitals represented in the input data file. The table below provides a summary of the PSIs that are dependent on e-codes for their definition (required), the PSIs that use e-codes within their definition, and the PSIs that do not use any e-codes in their definition. If use of e-codes is not mandated or coding may be highly variable across hospitals, the PSIs that are dependent upon e-codes should not be used and the PSIs that include e-codes in their definition should be used with caution.

Indicator Number (used in software)	**Indicator Name**	**Use of External Cause-of-Injury Codes**
15 & 25	Accidental puncture or laceration	Required. Used in both the numerator and denominator definitions.
17	Birth trauma	Not used.
1	Complications of anesthesia	Required. Used in the numerator definition.
2	Death in low mortality DRGs	Not used.
3	Decubitus ulcer	Not used.
4	Failure to rescue	Not used.
5 & 21	Foreign body left during procedure	Required. Used in the numerator definition although the other ICD-9 CM codes may capture the same information.
6 & 22	Iatrogenic pneumothorax	Not used.
20	Obstetric trauma – cesarean section	Not used.
18	Obstetric trauma – vaginal with instrument	Not used.
19	Obstetric trauma – vaginal without instrument	Not used.
9	Post-operative hemorrhage or hematoma	Not used.
8	Post-operative hip fracture	Used as exclusion criteria in denominator population.
10	Post-operative physiologic and metabolic derangements	Not used.
12	Post-operative pulmonary embolism or deep vein thrombosis	Not used.
11	Post-operative respiratory failure	Not used.
13	Post-operative sepsis	Not used.
14 & 24	Post-operative wound dehiscence	Not used.
7 & 23	Selected infections due to medical care	Not used.
16 & 26	Transfusion reaction	Required. Used in the numerator definition although the other ICD-9 CM codes may capture the same information.

Detailed Evidence for Patient Safety Indicators

This section provides an abbreviated presentation of the details of the literature review and the empirical evaluation for each PSI, including:

- The definition of the indicator
- The outcome of interest (or numerator)
- The population at risk (or denominator)
- The type of indicator
- The measures of empirical performance. Rates are per 1,000 qualifying discharges, rather than the average hospital rates reported in the previous table.

The two-page descriptions for each indicator also include a more detailed discussion of the panel review, the literature review, the source of the indicator, and the results of the empirical analysis, including information related to adjustments to increase the robustness of the rates:

- Reliability. Statistics on the signal standard deviation, signal share, and signal ratio were used to examine the effect of the reliability adjustment. Multivariate methods were applied to most of the indicators, and overall the reliability adjustment reduced the hospital-level variation dramatically. In general, indicators with higher rates tend to perform better on tests of reliability, as a result, obstetric indicators with high rates tend to do very well relative to other indicators.

- Bias. The effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals — compared to no risk adjustment —was assessed, if applicable. The presence of high bias suggests that risk adjustment, using administrative data elements, is necessary to interpret hospital-level differences in the rates of these indicators.

A full report on the literature review and empirical evaluation can be found in *Evidence Report for Measures of patient Safety Based on Hospital Administrative Data — The Patient Safety Indicators* by the UCSF-Stanford EPC, available at **http:www.qualityindicators.ahrq.gov/**. Detailed coding information for each PSI is provided in Appendix A.

The software manual *Patient Safety Indicators: SAS Software Documentation, Version 2.1* (also available at http:www.qualityindicators.ahrq.gov) provides detailed instructions on how to use the PSI software including data preparation, calculation of the PSI rates, and interpretation of output. All hospital level indicators are expressed as rates per 1,000 discharges. To obtain the standardized rate for each hospital level PSIs, the output of the software should be multiplied by 1,000. The area level indicators are expressed as rates per 100,000 population. To obtain the standardized area rate for each area level PSIs, the output of the software should be multiplied by 100,000.

Complications of Anesthesia

Definition	Cases of anesthetic overdose, reaction, or endotrachial tube misplacement per 1,000 surgery discharges.
Numerator	Discharges with ICD-9-CM diagnosis codes for anesthesia complications in any secondary diagnosis field per 1,000 discharges.
Denominator	All surgical discharges defined by specific DRGs. Exclude patients with codes for poisoning due to anesthetics (E8551, 9681-4, 9687) and any diagnosis code for active drug dependence, active non-dependent abuse of drugs, or self-inflicted injury.
Type of Indicator	Hospital level
Empirical Performance	Rate: 0.55 per 1,000 population at risk Bias: Not detected, but may be biased in a way undetectable by empirical tests
Risk Adjustment	Age, sex, DRG, comorbidity categories

Summary

This indicator is intended to capture cases flagged by external cause-of-injury codes (e-codes) and complications codes for adverse effects from the administration of therapeutic drugs, as well as the overdose of anesthetic agents used primarily in therapeutic settings.

Panel Review

Panelists had concerns about the frequency of coding of these complications, especially since the use of e-codes is considered voluntary and appears to vary widely among providers. Plausibly, a "reaction" may be described without attributing it to anesthetic. Another concern is that some of these cases would be present on admission (e.g., due to recreational drug use).

Panelists expressed concern about the events that would be assigned to the code for incorrect placement of endotrachial tube. They noted that true misplacement does represent medical error, but they were skeptical about whether this code would be limited to those situations.

Ideally, this indicator would be used with a coding designation that distinguishes conditions present on admission from those that develop in-hospital. However, this is not available in the administrative data used to define this indicator, and so this concern was addressed by eliminating codes for drugs that are commonly used as recreational drugs. While this does not eliminate the chance that these codes represent intentional or accidental overdose on the part of the patient, it should eliminate many of these cases.

Literature Review

The literature review focused on the validity of complication indicators based on ICD-9-CM diagnosis or procedure codes. Results of the literature review indicate no published evidence for the sensitivity or predictive value of this indicator based on detailed chart review or prospective data collection. Sensitivity is the proportion of the patients who suffered an adverse event for whom that event was coded on a discharge abstract or Medicare claim. Predictive value is the proportion of patients with a coded adverse event who were confirmed as having suffered that event.

The project team found no published evidence for this indicator that supports the following constructs: (1) that hospitals that provide better processes of care experience fewer adverse events; (2) that hospitals that provide better overall care experience fewer adverse events; and (3) that hospitals that offer more nursing hours per patient day, better nursing skill mix, better physician skill mix, or more experienced physicians have fewer adverse events.

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Complications of

anesthesia generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is 75.7%, suggesting that observed differences in risk-adjusted rates likely reflect true differences across hospitals.

The signal standard deviation for this indicator is 0.00187, indicating that the systematic differences (signal) among hospitals is lower than many indicators and less likely associated with hospital characteristics. The signal share is 0.00563, and is also lower than many indicators. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The project team assessed the effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals compared to no risk adjustment. They measured (1) the impact of adjustment on the assessment of relative hospital performance, (2) the relative importance of the adjustment, (3) the impact on hospitals with the highest and lowest rates, and (4) the impact throughout the distribution. The detected bias for Complications of anesthesia is low, indicating that the measures are likely not biased based on the characteristics observed. (It is possible that characteristics that are not observed using administrative data may be related to the patient's risk of experiencing an adverse event.)

Source

A subset of this indicator was originally proposed by Iezzoni et al.[31] as part of Complications Screening Program (CSP) (CSP 21, "Complications relating to anesthetic agents and other CNS depressants") Their definition also includes poisoning due to centrally acting muscle relaxants and accidental poisoning by nitrogen oxides, which were omitted from this PSI. Their definition excludes other codes included in the PSI, namely, poisoning by other and unspecified general anesthetics and external cause of injury codes for "endotracheal tube wrongly place during anesthetic procedure" and adverse effects of anesthetics in therapeutic use.

[31] Iezzoni LI, Daley J, Heeren T, Foley SM, Fisher ES, Duncan C, et al. Identifying complications of care using administrative data. Med Care 1994;32(7):700-15.

Death in Low-Mortality DRGs

Definition	In-hospital deaths per 1,000 patients in DRGs with less than 0.5% mortality.
Numerator	Discharges with disposition of "deceased" per 1,000 population at risk.
Denominator	Patients in DRGs with less than 0.5% mortality rate, based on NIS 1997 low-mortality DRG. If a DRG is divided into "without/with complications," both DRGs must have mortality rates below 0.5% to qualify for inclusion. Exclude patients with any code for trauma, immunocompromised state, or cancer.
Type of Indicator	Hospital level
Empirical Performance	Rate: 0.66 per 1,000 population at risk Bias: Substantial bias; should be risk-adjusted
Risk Adjustment	Age, sex, DRG, comorbidity categories

Summary

This indicator is intended to identify in-hospital deaths in patients unlikely to die during hospitalization. The underlying assumption is that when patients admitted for an extremely low-mortality condition or procedure die, a health care error is more likely to be responsible. Patients experiencing trauma or having an immunocompromised state or cancer are excluded, as these patients have higher non-preventable mortality.

Panel Review

The overall usefulness of this indicator was rated as favorable by panelists. Because the denominator includes many heterogeneous patients cared for by different services, this indicator should be stratified by DRG type (i.e., medical, surgical, psychiatric, obstetric, pediatric) when used as an indicator of quality.

Panelists noted that hospital case-mix may affect the rate of death in low mortality DRGs, and that patients referred from skilled nursing facilities, those with certain comorbidities, and older patients may be at higher risk of dying. They advocated risk adjustment for comorbidities and age.

Panelists advocated that this indicator not be subject to public reporting because of the potential bias and questions about the extent of preventability.

Literature Review

Based on two-stage implicit review of randomly selected deaths, Hannan et al. found that patients in low-mortality DRGs (<0.5%) were 5.2 times more likely than all other patients who died (9.8% versus 1.7%) to have received "care that departed from professionally recognized standards," after adjusting for patient demographic, geographic, and hospital characteristics.[32] In 15 of these 26 cases (58%) of substandard care, the patient's death was attributed at least partially to that care. The association with substandard care was stronger for the DRG-based definition of this indicator than for the procedure-based definition (5.7% versus 1.7%, OR=3.2). The project team was unable to find other evidence on the validity of this indicator.

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Death in low-mortality DRGs generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences

[32] Hannan EL, Bernard HR, O'Donnell JF, Kilburn H, Jr. A methodology for targeting hospital cases for quality of care record reviews. Am J Public Health 1989;79(4):430-6.

(signal) in hospital performance rather than random variation (noise)—is high, relative to other indicators, at 94.2%, suggesting that observed differences in risk-adjusted rates likely reflect true differences across hospitals.

The signal standard deviation for this indicator is lower than many indicators, at 0.00439, indicating that the systematic differences (signal) among hospitals is low and less likely associated with hospital characteristics. The signal share is high, relative to other indicators, at 0.04237. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The project team assessed the effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals compared to no risk adjustment. They measured (1) the impact of adjustment on the assessment of relative hospital performance, (2) the relative importance of the adjustment, (3) the impact on hospitals with the highest and lowest rates, and (4) the impact throughout the distribution. The detected bias for Death in low-mortality DRGs is high, indicating that the measures are biased based on the characteristics observed. (It is possible that characteristics that are not observed using administrative data may be related to the patient's risk of experiencing an adverse event.) Risk adjustment is important for this indicator.

Source

This indicator was originally proposed by Hannan et al. as a criterion for targeting "cases that would have a higher percentage of quality of care problems than cases without the criterion, as judged by medical record review."[33] An alternative form of this indicator focused on "primary surgical procedures," rather than DRGs, with less than 0.5% inpatient mortality.

[33] Hannan et al. 1989.

Decubitus Ulcer

Definition	Cases of decubitus ulcer per 1,000 discharges with a length of stay greater than 4 days.
Numerator	Discharges with ICD-9-CM code of 7070 in any secondary diagnosis field per 1,000 discharges.
Denominator	All medical and surgical discharges defined by specific DRGs. Include only patients with a length of stay of 5 or more days. Exclude patients in MDC-9 or patients with any diagnosis of hemiplegia, paraplegia, or quadriplegia. Exclude obstetrical patients in MDC 14. Exclude patients admitted from a long-term care facility.
Type of Indicator	Hospital level
Empirical Performance	Rate: 22.7 per 1,000 population at risk Bias: Substantial bias; should be risk-adjusted
Risk Adjustment	Age, sex, DRG, comorbidity categories

Summary

This indicator is intended to flag cases of in-hospital decubitus ulcers. Its definition is limited to decubitus ulcer as a secondary diagnosis to better screen out cases that may be present on admission. In addition, this indicator excludes patients who have a length of stay of 4 days or less, as it is unlikely that a decubitus ulcer would develop within this period of time. Finally, this indicator excludes patients who are particularly susceptible to decubitus ulcer, namely patients with major skin disorders (MDC 9) and paralysis.

Panel Review

The overall usefulness of this indicator was rated as very favorable by panelists. Concerns regarding the systematic screening for ulcers and reliability of coding, especially for early stage ulcers, brought into question that assertion. Therefore, this indicator appears to be best used as a rate-based indicator. Panelists suggested that patients admitted from a long-term care facility be excluded, as these patients may have an increased risk of having decubiti present on admission.

Panelists noted that hospitals that routinely screen for decubitus ulcers as part of a quality improvement program might have an artificially high rate of ulcers compared to other hospitals, which may cause this indicator to be somewhat biased.

This indicator includes pediatric patients. Pressure sores are very unusual in children, except among the most critically ill children (who may be paralyzed to improve ventilator management) and children with chronic neurological problems. Age stratification is recommended.

Literature Review

Coding validity. No evidence on validity is available from CSP studies. Geraci et al. confirmed only 2 of 9 episodes of pressure ulcers reported on discharge abstracts of Veterans Affairs (VA) patients hospitalized in 1987-89 for congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), or diabetes.[34] The sensitivity for a nosocomial ulcer was 40%. Among Medicare hip fracture patients, Keeler et al. confirmed 6 of 9 reported pressure ulcers, but failed to ascertain 89

[34] Geraci JM, Ashton CM, Kuykendall DH, Johnson ML, Wu L. International Classification of Diseases, 9th Revision, Clinical Modification codes in discharge abstracts are poor measures of complication occurrence in medical inpatients. Med Care 1997;35(6):589-602.

additional cases (6% sensitivity) using ICD-9-CM codes.[35] In the largest study to date, Berlowitz et al. found that the sensitivity of a discharge diagnosis of pressure ulcer among all patients transferred from VA hospitals to VA nursing homes in 1996 was 31% overall, or 54% for stage IV (deep) ulcers.[36] The overall sensitivity increased modestly since 1992 (26.0%), and was slightly but statistically significantly better among medical patients than among surgical patients (33% versus 26%).

Construct validity. Needleman and Buerhaus found that nurse staffing was inconsistently associated with the occurrence of pressure ulcers among medical patients, and was independent of pressure ulcers among major surgery patients.[37] As was expected, nursing skill mix (RN hours/licensed nurse hours) was significantly associated with the pressure ulcer rate.[38] Total licensed nurse hours per acuity-adjusted patient day were inconsistently associated with the rate of pressure ulcers.

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Decubitus ulcer generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is high, relative to other indicators, at 85.6%, suggesting that observed differences in risk-adjusted rates likely reflect true differences across hospitals.

The signal standard deviation for this indicator is lower than many indicators, at 0.0147, indicating that the systematic differences (signal) among hospitals is low and less likely associated with hospital characteristics. The signal share is lower than many indicators, at 0.01067. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The project team assessed the effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals compared to no risk adjustment. They measured (1) the impact of adjustment on the assessment of relative hospital performance, (2) the relative importance of the adjustment, (3) the impact on hospitals with the highest and lowest rates, and (4) the impact throughout the distribution. The detected bias for Decubitus ulcer is high, indicating that the measure is biased based on the characteristics observed. (It is possible that characteristics that are not observed using administrative data may be related to the patient's risk of experiencing an adverse event.) Risk adjustment is important for this indicator.

Source

This indicator was originally proposed by Iezzoni et al.[39] as part of the Complications Screening Program (CSP 6, "cellulitis or decubitus ulcer"). Needleman and Buerhaus identified decubitus ulcer as an "outcome potentially sensitive to nursing"[40] The American Nurses Association, its State associations, and the California Nursing Outcomes Coalition have identified the total prevalence of inpatients with Stage I, II, III, or IV pressure ulcers as a "nursing-sensitive quality indicator for acute care settings."[41]

[35] Keeler E, Kahn K, Bentow S. Assessing quality of care for hospitalized Medicare patients with hip fracture using coded diagnoses from the Medicare Provider Analysis and Review file. Springfield, VA: NTIS; 1991.

[36] Berlowitz D, Brand H, Perkins C. Geriatric syndromes as outcome measures of hospital care: Can administrative data be used? JAGS 1999;47:692-696.

[37] Needleman J, Buerhaus PI, Mattke S, Stewart M, Zelevinsky K. Nurse Staffing and Patient Outcomes in Hospitals. Boston, MA: Health Resources Services Administration; 2001 February 28. Report No.: 230-88-0021.

[38] Lichtig LK, Knauf RA, Hilholland DK. Some impacts of nursing on acute care hospital outcomes. J Nurs Adm 1999;29(2):25-33.

[39] Iezzoni LI, Daley J, Heeren T, Foley SM, Risher ES, Duncan C, et al. Identifying complications of care using administrative data. Med Care 1994;32(7):700-15.

[40] Needleman et al. 2001.

[41] Nursing-Sensitive Quality Indicators for Acute Care Settings and ANA's Safety & Quality Initiative. In: American Nurses Association; 1999.

Failure to Rescue

Definition	Deaths per 1,000 patients having developed specified complications of care during hospitalization.
Numerator	Discharges with a disposition of "deceased" per 1,000 population at risk.
Denominator	Discharges with potential complications of care listed in failure to rescue definition (i.e., pneumonia, DVT/PE, sepsis, acute renal failure, shock/cardiac arrest, or GI hemorrhage/acute ulcer). Exclusion criteria specific to each diagnosis. Exclude patients age 75 years and older. Exclude neonatal patients in MDC 15. Exclude patients transferred to an acute care facility. Exclude patients transferred from an acute care facility. Exclude patients admitted from a long-term care facility.
Type of Indicator	Hospital level
Empirical Performance	Rate: 148.4 per 1,000 population at risk Bias: Substantial bias; should be risk-adjusted
Risk Adjustment	Age, sex, DRG, comorbidity categories

Summary

This indicator is intended to identify patients who die following the development of a complication. The underlying assumption is that good hospitals identify these complications quickly and treat them aggressively.

Failure to rescue may be fundamentally different than other indicators reviewed in this report, as it may reflect different aspects of quality of care (effectiveness in rescuing a patient from a complication versus preventing a complication). This indicator includes pediatric patients. It is important to note that children beyond the neonatal period inherently recover better from physiological stress and thus may have a higher rescue rate.

Panel Review

Panelists expressed concern regarding patients with "do not resuscitate" (DNR) status. In cases where this DNR status is not a direct result of poor quality of care, it would be contrary to patient desire and poor quality of care to rescue a patient. In addition, very old patients—or patients with advanced cancer or HIV—may not desire or may be particularly difficult to rescue from these complications. As a result, this indicator definition was modified to exclude those patients age 75 years and older. In addition, panelists suggested the exclusion of patients admitted from long-term care facilities.

Panelists noted that several adverse incentives may be introduced by implementing this indicator. In particular, since some type of adjustment may be desirable, this indicator may encourage the upcoding of complications and comorbidities to inflate the denominator or manipulate risk adjustment. Others noted that this indicator could encourage irresponsible resource use and allocation, although this is likely to be a controversial idea. Finally, panelists emphasized that this indicator should be used internally by hospitals, as it is not validated for public reporting.

Literature Review

Construct validity. Silber and colleagues have published a series of studies establishing the construct validity of failure to rescue rates through their associations with hospital characteristics and other measures of hospital performance. Among patients admitted for cholecystectomy and transurethral

prostatectomy, failure to rescue was independent of severity of illness at admission, but was significantly associated with the presence of surgical house staff and a lower percentage of board-certified anesthesiologists.[42] The adverse occurrence rate was independent of this hospital characteristic. In a larger sample of patients who underwent general surgical procedures, lower failure to rescue rates were found at hospitals with high ratios of registered nurses to beds.[43] Failure rates were strongly associated with risk-adjusted mortality rates, as expected, but not with complication rates.[44]

More recently, Needleman and Buerhaus confirmed that higher registered nurse staffing (RN hours/adjusted patient day) and better nursing skill mix (RN hours/licensed nurse hours) were consistently associated with lower failure to rescue rates, even using administrative data to define complications.[45]

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Failure to rescue generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is moderately high, relative to other indicators, at 66.6%, suggesting that observed differences in risk-adjusted rates may reflect true differences across hospitals.

The signal standard deviation for this indicator is also high, relative to other indicators, at 0.04617, indicating that the systematic differences (signal) among hospitals is high and more likely associated with hospital characteristics. The signal share is lower than many indicators, at 0.01450. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The project team assessed the effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals compared to no risk adjustment. They measured (1) the impact of adjustment on the assessment of relative hospital performance, (2) the relative importance of the adjustment, (3) the impact on hospitals with the highest and lowest rates, and (4) the impact throughout the distribution. The detected bias for Failure to rescue is high, indicating that the measures are biased based on the characteristics observed. (It is possible that characteristics that are not observed using administrative data may be related to the patient's risk of experiencing an adverse event.) Risk adjustment is important for this indicator.

Source

This indicator was originally proposed by Silber et al. as a more powerful tool than the risk-adjusted mortality rate to detect true differences in patient outcomes across hospitals.[46] The underlying premise was that better hospitals are distinguished not by having fewer adverse occurrences but by more successfully averting death among (i.e., rescuing) patients who experience such complications. More recently, Needleman and Buerhaus adapted Failure to rescue to administrative data sets, hypothesizing that this outcome might be sensitive to nurse staffing.[47]

[42] Silber JH, Williams SV, Krakauer H, Schwartz JS. Hospital and patient characteristics associated with death after surgery. A study of adverse occurrence and failure to rescue. Med Care 1992;30(7):615-29.

[43] Silber J, Rosenbaum P, Ross R. Comparing the contributions of groups of predictors: Which outcomes vary with hospital rather than patient characteristics? J Am Stat Assoc 1995;90:7-18.

[44] Silber JH, Rosenbaum PR, Williams SV, Ross RN, Schwartz JS. The relationship between choice of outcome measure and hospital rank in general surgical procedures: Implications for quality assessment. Int J Qual Health Care 1997;9(3):193-200.

[45] Needleman J, Buerhaus PI, Mattke S, Stewart M, Zelevinsky K. Nurse Staffing and Patient Outcomes in Hospitals. Boston MA: Health Resources and Services Administration; 2001 February 28. Report No.:230-99-0021.

[46] Silber et al. 1992.

[47] Needleman et al. 2001.

Foreign Body Left During Procedure

Hospital Level Definition

Definition	Discharges with foreign body accidentally left in during procedure per 1,000 discharges.
Numerator	Discharges with ICD-9-CM codes for foreign body left in during procedure in any secondary diagnosis field per 1,000 surgical discharges.
Denominator	All medical and surgical discharges defined by specific DRGs.
Type of Indicator	Hospital level
Empirical Performance	Rate: 0.09 per 1,000 population at risk Bias: Did not undergo empirical testing of bias
Risk Adjustment	Age, sex, DRG, comorbidity categories

Foreign Body Left During Procedure

Area Level Definition

Definition	Discharges with foreign body accidentally left in during procedure per 100,000 population.
Numerator	Discharges with ICD-9-CM codes for foreign body left in during procedure in any diagnosis field (principal or secondary) of medical and surgical discharges defined by specific DRGs.
Denominator	Population of county or MSA associated with FIPS code of patient's residence or hospital location.
Type of Indicator	Area level
Empirical Performance	Rate: 1.05 per 100,000 population
Risk Adjustment	No risk adjustment

Summary

This indicator is intended to flag cases of a foreign body accidentally left in a patient during a procedure. This indicator is defined on both a hospital level (by restricting cases to those flagged by a secondary diagnosis or procedure code) and an area level (by including all cases).

Panel Review

Panelists believed that this indicator was useful in identifying cases of a foreign body left in during a procedure. However, they suggested that each case identified be examined carefully by the hospital, because this indicator was likely to yield few cases and some automated systems report this complication when a foreign body is left in intentionally.

Panelists also noted that the population at risk included both medical and surgical patients, but not all of these patients are at risk. The panelists felt that limiting the population at risk to surgical patients would decrease the sensitivity of this indicator substantially. Since not all patients in the denominator are actually at risk, some hospitals may appear to have a lower rate if they have fewer medical patients who have undergone invasive procedures.

Literature Review

The literature review focused on the validity of complication indicators based on ICD-9-CM diagnosis or procedure codes. Results of the literature review indicate no published evidence for the sensitivity or predictive value of this indicator based on detailed chart review or prospective data collection. Sensitivity is the proportion of the patients who suffered an

adverse event for whom that event was coded on a discharge abstract or Medicare claim. Predictive value is the proportion of patients with a coded adverse event who were confirmed as having suffered that event.

The project team found no published evidence for this indicator that supports the following constructs: (1) that hospitals that provide better processes of care experience fewer adverse events; (2) that hospitals that provide better overall care experience fewer adverse events; and (3) that hospitals that offer more nursing hours per patient day, better nursing skill mix, better physician skill mix, or more experienced physicians have fewer adverse events.

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Foreign body left during procedure generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time. Due to the rarity of this diagnosis, reliability and bias were not assessed.

Source

This indicator was originally proposed by Iezzoni et al. as part of the Complications Screening Program (CSP "sentinel events").[48] It was also included as one component of a broader indicator ("adverse events and iatrogenic complications") in AHRQ's original HCUP Quality Indicators.[49] It was proposed by Miller et al. in the "Patient Safety Indicator Algorithms and Groupings."[50] Based on expert consensus panels, McKesson Health Solutions included this indicator in its CareEnhance Resource Management Systems, Quality Profiler Complications Measures Module.

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[48] Iezzoni LI, Daley J, Heeren T, Foley SM, Fisher ES, Duncan C, et al. Identifying complications of care using administrative data. Med Care 1994;32(7):700-15.

[49] Johantgen M, Elixhauser A, Bali JK, Goldfarb M, Harris DR. Quality indicators using hospital discharge data: state and national applications. Jt Comm J Qual Improv 1998;24(2):88-105.

[50] Miller M, Elixhauser A, Zhan C, Meyer G. Patient safety indicators: Using administrative data to identify potential patient safety concerns. Health Services Research 2001;36(6 Part II):110-132.

Iatrogenic Pneumothorax

Hospital Level Definition

Definition	Cases of iatrogenic pneumothorax per 1,000 discharges.
Numerator	Discharges with ICD-9-CM code of 512.1 in any secondary diagnosis field per 1,000 discharges.
Denominator	All discharges. Exclude patients with any diagnosis of trauma. Exclude patients with any code indicating thoracic surgery or lung or pleural biopsy or assigned to cardiac surgery DRGs. Exclude obstetrical patients in MDC 14.
Type of Indicator	Hospital level
Empirical Performance	Rate: 0.83 per 1,000 population at risk Bias: Some bias demonstrated
Risk Adjustment	Age, sex, DRG, comorbidity categories

Iatrogenic Pneumothorax

Area Level Definition

Definition	Cases of iatrogenic pneumothorax per 100,000 population.
Numerator	Discharges with ICD-9-CM code of 512.1 in any diagnosis field (principal or secondary). Exclude patients with any diagnosis of trauma. Exclude patients with any code indicating thoracic surgery or lung or pleural biopsy or assigned to cardiac surgery DRGs. Exclude obstetrical patients in MDC 14.
Denominator	Population of county or MSA associated with FIPS code of patient's residence or hospital location.
Type of Indicator	Area level
Empirical Performance	Rate: 8.15 per 100,000 population
Risk Adjustment	No risk adjustment

Summary

This indicator is intended to flag cases of pneumothorax caused by medical care. This indicator is defined on both a hospital level (by including cases of iatrogenic pneumothorax occurring as a secondary diagnosis during hospitalization) and on an area level (by including all cases of iatrogenic pneumothorax).

Iatrogenic pneumothorax excludes all trauma patients because these patients may be more susceptible to non-preventable iatrogenic pneumothorax or may be miscoded for traumatic pneumothorax. The smaller anatomy of children, especially neonates, may increase the technical complexity of these procedures in this population (however, these procedures are less likely to be performed in unmonitored settings).

Panel Review

Panelists rated the overall usefulness of this indicator favorably. The denominator of the

definition that the panelists rated was limited to patients receiving a central line, Swan-Ganz catheter, or thorocentesis. However, exploratory empirical analyses found that this definition could not be operationalized using administrative data, as these procedures appeared to be under-reported. Although the panelists noted that this complication, given the definition rated, reflected medical error, the actual final definition of this indicator includes cases that may be less reflective of medical error. Specifically, this indicator includes patients in whom a pneumothorax resulted from barotrauma, including patients with acute respiratory distress syndrome.

Panelists expressed concern that some approaches of placing a central line (e.g., subclavian) may be more likely to result in pneumothorax than other approaches (e.g., internal jugular). However, other complications—such as complications of the carotid artery—would be more common with internal jugular approaches. Thus, if providers simply change approach, they may have a decrease in pneumothorax but an increase in other unmeasured complications.

Literature Review

The literature review focused on the validity of complication indicators based on ICD-9-CM diagnosis or procedure codes. Results of the literature review indicate no published evidence for the sensitivity or predictive value of this indicator based on detailed chart review or prospective data collection. Sensitivity is the proportion of the patients who suffered an adverse event for whom that event was coded on a discharge abstract or Medicare claim. Predictive value is the proportion of patients with a coded adverse event who were confirmed as having suffered that event.

The project team found no published evidence for this indicator that supports the following constructs: (1) that hospitals that provide better processes of care experience fewer adverse events; (2) that hospitals that provide better overall care experience fewer adverse events; and (3) that hospitals that offer more nursing hours per patient day, better nursing skill mix, better physician skill mix, or more experienced physicians have fewer adverse events.

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Iatrogenic pneumothorax generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is moderately high, relative to other indicators, at 79.9%, suggesting that observed differences in risk-adjusted rates may reflect true differences across hospitals.

The signal standard deviation for this indicator is lower than many indicators, at 0.00143, indicating that the systematic differences (signal) among hospitals is low and less likely associated with hospital characteristics. The signal share is lower than many indicators, at 0.00183. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The project team assessed the effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals compared to no risk adjustment. They measured (1) the impact of adjustment on the assessment of relative hospital performance, (2) the relative importance of the adjustment, (3) the impact on hospitals with the highest and lowest rates, and (4) the impact throughout the distribution. The detected bias for Iatrogenic pneumothorax is moderate, indicating that the measures may or may not be substantially biased based on the characteristics observed.

Source

This diagnosis code was proposed by Miller et al. as one component of a broader indicator ("iatrogenic conditions") in the "Patient Safety Indicator Algorithms and Groupings."[51] It was also included as one component of a broader indicator ("adverse events and iatrogenic complications") in AHRQ's Version 1.3 HCUP Quality Indicators.

[51] Miller M, Elixhauser A, Zhan C, Meyer G. Patient safety indicators: Using administrative data to identify potential patient safety concerns. Health Services Research 2001;36(6 Part II):110-132.

Selected Infections Due to Medical Care

Hospital Level Definition

Definition	Cases of ICD-9-CM codes 9993 or 99662 per 1,000 discharges.
Numerator	Discharges with ICD-9-CM code of 9993 or 99662 in any secondary diagnosis field per 1,000 discharges.
Denominator	All medical and surgical discharges defined by specific DRGs. Exclude patients with any diagnosis code for immunocompromised state or cancer.
Type of Indicator	Hospital level
Empirical Performance	Rate: 1.99 per 1,000 population at risk Bias: Some bias demonstrated
Risk Adjustment	Age, sex, DRG, comorbidity categories

Selected Infections Due to Medical Care

Area Level Definition

Definition	Cases of ICD-9-CM codes 9993 or 99662 per 100,000 population.
Numerator	Discharges with ICD-9-CM code of 9993 or 99662 in any diagnosis field (principal or secondary) of medical and surgical discharges defined by specific DRGs. Exclude patients with any diagnosis code for immunocompromised state or cancer.
Denominator	Population of county or MSA associated with FIPS code of patient's residence or hospital location.
Type of Indicator	Area level
Empirical Performance	Rate: 34.18 per 100,000 population
Risk Adjustment	No risk adjustment

Summary

This indicator is intended to flag cases of infection due to medical care, primarily those related to intravenous (IV) lines and catheters. This indicator is defined both on a hospital level (by including cases based on secondary diagnosis associated with the same hospitalization) and on an area level (by including all cases of such infection). Patients with potential immunocompromised states (e.g., AIDS, cancer, transplant) are excluded, as they may be more susceptible to such infection.

This indicator includes children and neonates. It should be noted that high-risk neonates are at particularly high risk for catheter-related infections.

Panel Review

Panelists expressed particular interest in tracking IV and catheter-related infections, despite the potential for bias due to charting or under-reporting. For the most part, they felt that these complications were important to track. As with other indicators tracking infections, concern regarding the potential overuse of prophylactic antibiotics remains.

Literature Review

The literature review focused on the validity of complication indicators based on ICD-9-CM

diagnosis or procedure codes. Results of the literature review indicate no published evidence for the sensitivity or predictive value of this indicator based on detailed chart review or prospective data collection. Sensitivity is the proportion of the patients who suffered an adverse event for whom that event was coded on a discharge abstract or Medicare claim. Predictive value is the proportion of patients with a coded adverse event who were confirmed as having suffered that event.

The project team found no published evidence for this indicator that supports the following constructs: (1) that hospitals that provide better processes of care experience fewer adverse events; (2) that hospitals that provide better overall care experience fewer adverse events; and (3) that hospitals that offer more nursing hours per patient day, better nursing skill mix, better physician skill mix, or more experienced physicians have fewer adverse events.

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Selected infections due to medical care generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is moderately high, relative to other indicators, at 70.8%, suggesting that observed differences in risk-adjusted rates may reflect true differences across hospitals.

The signal standard deviation for this indicator is lower than many indicators, at 0.00134, indicating that the systematic differences (signal) among hospitals is low and less likely associated with hospital characteristics. The signal share is lower than many indicators, at 0.00095. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The project team assessed the effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals compared to no risk adjustment. They measured (1) the impact of adjustment on the assessment of relative hospital performance, (2) the relative importance of the adjustment, (3) the impact on hospitals with the highest and lowest rates, and (4) the impact throughout the distribution. The detected bias for Selected infections due to medical care is moderate, indicating that the measures may or may not be substantially biased based on the characteristics observed. (It is possible that characteristics that are not observed using administrative data may be related to the patient's risk of experiencing an adverse event.)

Source

This indicator was originally proposed by Iezzoni et al. as part of the Complications Screening Program (CSP 11, "miscellaneous complications").[52] The University HealthSystem Consortium adopted the CSP indicator for major (#2933) and minor (#2961) surgery patients. A much narrower definition, including only 9993 ("other infection after infusion, injection, transfusion, vaccination"), was proposed by Miller et al. in the "Patient Safety Indicator Algorithms and Groupings."[53] The American Nurses Association and its State associations have identified the number of laboratory-confirmed bacteremic episodes associated with central lines per critical care patient day as a "nursing-sensitive quality indicator for acute care settings."[54]

[52] Iezzoni LI, Daley J, Heeren T, Foley SM, Fisher ES, Duncan C, et al. Identifying complications of care using administrative data. Med Care 1994;32(7):700-15.

[53] Miller M, Elixhauser A, Zhan C, Meyer G. Patient safety indicators: Using administrative data to identify potential patient safety concerns. Health Services Research 2001;36(6 Part II):110-132.

[54] Nursing-Sensitive Quality Indicators for Acute Care Settings and ANA's Safety and Quality Initiative. In: American Nurses Association; 1999.

Postoperative Hemorrhage or Hematoma

Definition	Cases of hematoma or hemorrhage requiring a procedure per 1,000 surgical discharges.
Numerator	Discharges with ICD-9-CM codes for postoperative hemorrhage or postoperative hematoma in any secondary diagnosis field and code for postoperative control of hemorrhage or drainage of hematoma (respectively) in any secondary procedure code field per 1,000 discharges. Procedure code for postoperative control of hemorrhage or hematoma must occur on the same day or after the principal procedure. *Note: If day of procedure is not available in the input data file, the rate may be slightly higher than if the information was available*.
Denominator	All surgical discharges defined by specific DRGs. Exclude obstetrical patients in MDC 14.
Type of Indicator	Hospital level
Empirical Performance	Rate: 1.61 per 1,000 population at risk Bias: Not detected in empirical tests
Risk Adjustment	Age, sex, DRG, comorbidity categories

Summary

This indicator is intended to capture cases of hemorrhage or hematoma following a surgical procedure. This indicator limits hemorrhage and hematoma codes to secondary procedure and diagnosis codes, respectively, to isolate those hemorrhages that can truly be linked to a surgical procedure.

Panel Review

Panelists noted that some patients may be at higher risk for developing a postoperative hemorrhage or hematoma. Specifically, they were concerned about patients with coagulopathies and those on anticoagulants. They suggested that where possible, this indicator be stratified for patients with underlying clotting differences. They also noted that patients admitted for trauma may be at a higher risk for developing postoperative hemorrhage or may have a hemorrhage diagnosed that occurred during the trauma. They also suggested that this indicator be stratified for trauma and non-trauma patients.

Literature Review

Coding validity. The original CSP definition had a relatively high confirmation rate among major surgical cases (83% by coders' review, 57% by physicians' review, 52% by nurse-abstracted clinical documentation, and 76% if nurses also accepted physicians' notes as adequate documentation).[55] [56] [57] Hartz and Kuhn estimated the validity of hemorrhage codes using a gold standard based on transfusion "requirement."[58] They identified only 26% of

[55] Lawthers A, McCarthy E, Davis R, Peterson L, Palmer R, Iezzoni L. Identification of in-hospital complications from claims data: Is it valid? Med Care 2000;38(8):785-795.

[56] McCarthy EP, Iezzoni LI, Davis RB, Palmer RH, Cahalane M, Hamel MB, et al. Does clinical evidence support ICD-9-CM diagnosis coding of complications? Med Care 2000;38(8):868-876.

[57] Weingart SN, Iezzoni LI, Davis RB, Palmer RH, Cahalane M, Hamel MB, et al. Use of administrative data to find substandard care: Validation of the Complications Screening Program. Med Care 2000;38(8):796-806.

[58] Hartz AJ, Kuhn EM. Comparing hospitals that perform coronary artery bypass surgery: The effect of

episodes of bleeding (defined as requiring return to surgery or transfusion of at least six units of blood products) by applying this indicator (9981) to Medicare patients who underwent coronary artery bypass surgery; the predictive value was 75%.

Construct Validity. Explicit process of care failures in the CSP validation study were relatively frequent among major surgical cases with CSP 24, but not among medical cases (66% and 13%, respectively), after excluding patients who had hemorrhage or hematoma at admission.[59] Cases flagged on this indicator and unflagged controls did not differ significantly on a composite of 17 generic process criteria. Similarly, cases flagged on this indicator and unflagged controls did not differ significantly on a composite of four specific process criteria for major surgical cases and two specific process criteria for medical cases in the earlier study of elderly Medicare beneficiaries.[60]

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Postoperative hemorrhage or hematoma generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is lower than most indicators, at 8.6%, suggesting that observed differences in risk-adjusted rates may not reflect true differences across hospitals.

The signal standard deviation for this indicator is lower than most indicators, at 0.00039, indicating that the systematic differences (signal) among hospitals is low and less likely associated with hospital characteristics. The signal share is lower than many indicators, at 0.00006. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The project team assessed the effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals compared to no risk adjustment. They measured (1) the impact of adjustment on the assessment of relative hospital performance, (2) the relative importance of the adjustment, (3) the impact on hospitals with the highest and lowest rates, and (4) the impact throughout the distribution. The detected bias for Postoperative hemorrhage or hematoma is low, indicating that the measures are likely not biased based on the characteristics observed. (It is possible that characteristics that are not observed using administrative data may be related to the patient's risk of experiencing an adverse event.)

Source

This indicator was originally proposed by Iezzoni et al.[61] as part of the Complications Screening Program (CSP 24, "post-procedural hemorrhage or hematoma"), although their definition allowed either procedure or diagnosis codes. By contrast, the current definition requires a hemorrhage or hematoma diagnosis with an associated procedure to either control the hemorrhage or drain the hematoma. It was also included as one component of a broader indicator ("adverse events and iatrogenic complications") in AHRQ's original HCUP Quality Indicators.[62]

outcome measures and data sources. Am J Public Health 1994;84(10):1609-14.

[59] Iezzoni LI, Davis RB, Palmer RH, Cahalane M, Hamel MB, Mukamal K, et al. Does the complications Screening Program flag case with process of care problems? Using explicit criteria to judge processes. Int J Qual Health Care 1999;11(2):107-18.

[60] Iezzoni L, Lawthers A, Petersen L, McCarthy E, Palmer R, Cahalane M, et al. Project to validate the Complications Screening Program: Health Care Financing Administration; 1998 March 31. Report No: HCFA Contract 500-94-0055.

[61] Iezzoni LI, Daley J, Heeren T, Foley SM, Fisher ES, Duncan C, et al. Identifying complications of care using administrative data. Med Care 1994;32(7):700-15.

[62] Johantgen M, Elixhauser A, Bali JK, Goldfarb M, Harris DR. Quality indicators using hospital discharge data: State and national applications. Jt Comm J Qual Improv 1998;24(2):88-105. Published erratum appears in Jt Comm J Qual Improv 1998;24(6):341.

Postoperative Hip Fracture

Definition	Cases of in-hospital hip fracture per 1,000 surgical discharges.
Numerator	Discharges with ICD-9-CM code for fracture in any secondary diagnosis field per 1,000 surgical discharges.
Denominator	All surgical discharges defined by specific DRGs. Exclude all patients with diseases and disorders of the musculoskeletal system and connective tissue (MDC 8). Exclude patients with principal diagnosis codes for seizure, syncope, stroke, coma, cardiac arrest, anoxic brain injury, poisoning, delirium or other psychoses, trauma. Exclude patients with any diagnosis of metastatic cancer, lymphoid malignancy, bone malignancy or self-inflicted injury. Exclude obstetrical patients in MDC 14. Exclude patients 17 years of age or younger.
Type of Indicator	Hospital level
Empirical Performance	Rate: 0.94 per 1,000 population at risk Bias: Some bias demonstrated
Risk Adjustment	Age, sex, DRG, comorbidity categories

Summary

This indicator is intended to capture cases of in-hospital fracture—specifically, hip fractures. This indicator limits diagnosis codes to secondary diagnosis codes to eliminate fractures that were present on admission. It further excludes patients in MDC 8 (musculoskeletal disorders) and patients with indications for trauma or cancer, or principal diagnoses of seizure, syncope, stroke, coma, cardiac arrest, or poisoning, as these patients may have a fracture present on admission. This indicator is limited to surgical cases since previous research suggested that these codes in medical patients often represent conditions present on admission (see Literature Review).

Panel Review

Although this indicator was initially presented as "In-hospital hip fracture and fall," panelists unanimously suggested that falls should be eliminated from this indicator and that all in-hospital fractures should be included. The resulting indicator was termed "In-hospital fracture possibly related to falls." Children were excluded after empirical analysis revealed that they did not have a substantial number of cases in the numerator.

Panelists noted that this indicator may be slightly biased for hospitals that care for more of the elderly and frail, because they have weaker bones and are more susceptible to falls.

Panelists were interested in capturing all fractures occurring in-hospital, although it was not possible to operationalize this suggestion.

Literature Review

Coding validity. The original CSP definition had an adequate confirmation rate among major surgical cases in Medicare inpatient claims files (57% by coders' review, 71% by physicians' review), but a very poor confirmation rate among medical cases (11% by both coders' and physicians' review).[63] [64] This problem was

[63] Lawthers A, McCarthy E, Davis R, Peterson L, Palmer R, Iezzoni L. Identification of in-hospital complications from claims data: Is it valid? Med Care 2000;38(8):785-795.

[64] Weingart SN, Iezzoni LI, Davis RB, Palmer RH, Cahalane M, Hamel MB, et al. Use of administrative

attributable to the fact that most hip fractures among medical inpatients were actually comorbid diagnoses present at admission rather than complications of hospital care. Nurse reviews were not performed.

Construct validity. Explicit process of care failures in the CSP validation study were relatively frequent among cases with CSP 25 (76% of major surgery patients, 54% of medical patients), after excluding patients who had hip fractures at admission, but unflagged controls were not evaluated on the same criteria.[65] Physician reviewers identified potential quality problems in 24% of major surgery patients and 5% of medical patients with CSP 25 (versus 2% of unflagged controls for each risk group).[66]

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Postoperative hip fracture generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is moderately high, relative to other indicators, at 67.1%, suggesting that observed differences in risk-adjusted rates may reflect true differences across hospitals.

The signal standard deviation for this indicator is lower than many indicators, at 0.00184, indicating that the systematic differences (signal) among hospitals is low and less likely associated with hospital characteristics. The signal share is lower than many indicators, at 0.00403. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The project team assessed the effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals compared to no risk adjustment. They measured (1) the impact of adjustment on the assessment of relative hospital performance, (2) the relative importance of the adjustment, (3) the impact on hospitals with the highest and lowest rates, and (4) the impact throughout the distribution. The detected bias for Postoperative hip fracture is moderate, indicating that the measures may or may not be substantially biased based on the characteristics observed. (It is possible that characteristics that are not observed using administrative data may be related to the patient's risk of experiencing an adverse event.)

Source

This indicator was originally proposed by Iezzoni et al.[67] as part of the Complications Screening Program (CSP 25, "in-hospital hip fracture or fall"). Their definition also includes any documented fall, based on external cause of injury codes. Needleman and Buerhaus considered in-hospital hip fracture as an "Outcome Potentially Sensitive to Nursing," but discarded it because the "event rate was too low to be useful."[68] The American Nurses Association, its State associations, and the California Nursing Outcomes Coalition have identified the number of patient falls leading to injury per 1,000 patient days (based on clinical data collection) as a "nursing-sensitive quality indicator for acute care settings."[69]

data to find substandard care: Validation of the Complications Screening Program. Med Care 2000;38(8):796-806.

[65] Iezzoni LI, Davis RB, Palmer RH, Cahalane M, Hamel MB, Mukamal K, et al. Does the Complications Screening Program flag cases with process of care problems: Using explicit criteria to judge processes. Int J Qual Health Care 1999;11(2):107-18.

[66] Weingart et al. 2000.

[67] Iezzoni LI, Daley J, Heeren T, Foley SM, Fisher ES, Duncan C, et al. Identifying complications of care using administrative data. Med Care 1994;32(7):700-15.

[68] Needleman J, Buerhaus PI, Mattke S, Stewart M, Zelevinsky K. Nurse Staffing and Patient Outcomes in Hospitals. Boston, MA: Health Resources Services Administration; 2001 February 28. Report No.: 230-99-0021.

[69] Nursing-Sensitive Quality Indicators for Acute Care Settings and ANA's Safety & Quality Initiative. In: American Nurses Association; 1999.

Postoperative Physiologic and Metabolic Derangement

Definition	Cases of specified physiological or metabolic derangement per 1,000 elective surgical discharges.
Numerator	Discharges with ICD-9-CM codes for physiologic and metabolic derangements in any secondary diagnosis field per 1,000 elective surgical discharges. Discharges with acute renal failure (subgroup of physiologic and metabolic derangements) must be accompanied by a procedure code for dialysis (3995, 5498).
Denominator	All elective surgical discharges defined by admit type. Exclude patients with both a diagnosis code of ketoacidosis, hyperosmolarity, or other coma (subgroups of physiologic and metabolic derangements coding) and a principal diagnosis of diabetes. Exclude patients with both a secondary diagnosis code for acute renal failure (subgroup of physiologic and metabolic derangements coding) and a principal diagnosis of acute myocardial infarction, cardiac arrhythmia, cardiac arrest, shock, hemorrhage, or gastrointestinal hemorrhage. Exclude obstetrical patients in MDC 14.
Type of Indicator	Hospital level
Empirical Performance	Rate: 0.83 per 1,000 population at risk Bias: Some bias demonstrated
Risk Adjustment	Age, sex, DRG, comorbidity categories

Summary

This indicator is intended to flag cases of postoperative metabolic or physiologic complications. The population at risk is limited to elective surgical patients, because patients undergoing non-elective surgery may develop less preventable derangements. In addition, each diagnosis has specific exclusions, designed to reduce the number of flagged cases in which the diagnosis was present on admission or was more likely to be non-preventable.

Panel Review

Panelists expressed concern that acute renal failure suffers from the problem of varied definition: what one doctor may call acute renal failure, another may not. To ensure that the only renal failure cases that are picked up are those that are clinically severe, the panel suggested that acute renal failure be included only when it is paired with a procedure code for dialysis.

Panelists noted that coding of relatively transient metabolic and physiologic complications may be lacking, such as in cases of diabetic ketoacidosis. Conversely, some physicians may capture non-clinically significant events in this indicator.

This indicator includes pediatric patients, which was not specifically discussed by the panel. The incidence of these complications is a function of the underlying prevalence of diabetes and renal impairment, which are less common among children than among adults.

Literature Review

Coding validity. No evidence on validity is available from CSP studies. Geraci et al.[70]

[70] Geraci JM, Ashton CM, Kuykendall DH, Johnson ML, Wu L. International Classification of Diseases, 9th Revision, Clinical Modification codes in discharge abstracts are poor measures of complication occurrence in medical inpatients. Med Care 1997;35(6):589-602.

confirmed only 5 of 15 episodes of acute renal failure and 12 of 34 episodes of hypoglycemia reported on discharge abstracts of VA patients hospitalized for CHF, COPD, or diabetes. Romano reported no false positives in episodes of acute renal failure or hypoglycemia using discharge abstracts of diskectomy patients.[71] ICD-9-CM diagnoses (585 or 7885) had a sensitivity of 8% and a predictive value of 4% in comparison with the VA's National Surgical Quality Improvement Program database, which defines renal failure as requiring dialysis within 30 days after surgery.[72]

Construct Validity. After adjusting for patient demographic, geographic, and hospital characteristics, Hannan et al. reported that cases with a secondary diagnosis of fluid and electrolyte disorders were no more likely to have received care that departed from professionally recognized standards than cases without that code (2.2% versus 1.7%, OR=1.13).[73] However, these ICD-9-CM codes were omitted from the accepted AHRQ PSIs.

Empirical Evidence

The project team conducted extensive empirical analyses on the PSIs. Postoperative physiologic and metabolic derangements generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is lower than many indicators, at 20.9%, suggesting that observed differences in risk-adjusted rates may not reflect true differences across hospitals.

The signal standard deviation for this indicator is lower than many indicators, at 0.00054, indicating that the systematic differences (signal) among hospitals is low and less likely associated with hospital characteristics. The signal share is lower than many indicators, at 0.00033. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The project team assessed the effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals compared to no risk adjustment. They measured (1) the impact of adjustment on the assessment of relative hospital performance, (2) the relative importance of the adjustment, (3) the impact on hospitals with the highest and lowest rates, and (4) the impact throughout the distribution. The detected bias for Postoperative physiologic and metabolic derangements is moderate, indicating that the measures may or may not be substantially biased based on the characteristics observed. (It is possible that characteristics that are not observed using administrative data may or may not be related to the patient's risk of experiencing an adverse event.)

Source

This indicator was originally proposed by Iezzoni et al.[74] as part of the CSP (CSP 20, "postoperative physiologic and metabolic derangements"). The University HealthSystem Consortium adopted the CSP indicator for major surgery patients (#2945).

[71] Romano P. Can administrative data be used to ascertain clinically significant postoperative complications. American Journal of Medical Quality Press.

[72] Best W, Khuri S, Phelan M, Hur K, Henderson W, Demakis J, et al. Identifying patient preoperative risk factors and postoperative adverse events in administrative databases: Results from the Department of Veterans Affairs National Surgical Quality Improvement Program. J Am Coll Surg 2002;194(3):257-266.

[73] Hannan EL, Bernard HR, O'Donnell JF, Kilburn H, Jr. A methodology for targeting hospital cases for quality of care record reviews. Am J Public Health 1989;79(4):430-6.

[74] Iezzoni LI, Daley J, Heeren T, Foley SM, Fisher ES, Duncan C, et al. Identifying complications of care using administrative data. Med Care 1994;32(7):700-15.

Postoperative Pulmonary Embolism or Deep Vein Thrombosis

Definition	Cases of deep vein thrombosis (DVT) or pulmonary embolism (PE) per 1,000 surgical discharges.
Numerator	Discharges with ICD-9-CM codes for deep vein thrombosis or pulmonary embolism in any secondary diagnosis field per 1,000 surgical discharges.
Denominator	All surgical discharges defined by specific DRGs. Exclude patients with a principal diagnosis of deep vein thrombosis. Exclude obstetrical patients in MDC 14. Exclude patients with secondary procedure code 38.7 when this procedure occurs on the day of or previous to the day of the principal procedure. *Note: If day of procedure is not available in the input data file, the rate may be slightly lower than if the information was available*.
Type of Indicator	Hospital level
Empirical Performance	Rate: 9.59 per 1,000 population at risk Bias: Substantial bias; should be risk-adjusted
Risk Adjustment	Age, sex, DRG, comorbidity categories

Summary

This indicator is intended to capture cases of postoperative venous thromboses and embolism—specifically, pulmonary embolism and deep venous thrombosis. This indicator limits vascular complications codes to secondary diagnosis codes to eliminate complications that were present on admission. It further excludes patients who have principal diagnosis of DVT, as these patients are likely to have had PE/DVT present on admission.

Panel Review

Panelists rated the overall usefulness of this indicator relatively highly as compared to other indicators. They noted that preventative techniques should decrease the rate of this indicator. This indicator includes pediatric patients. In the absence of specific thrombophilic disorders, postoperative thromboembolic complications in children are most likely to be secondary to venous catheters rather than venous stasis in the lower extremities.

Because the risk for DVT/PE varies greatly according to the type of procedure performed, panelists suggested that this indicator be adjusted or stratified according to surgical procedure types.

Literature Review

Coding validity. Geraci et al. confirmed only 1 of 6 episodes of DVT or PE reported on discharge abstracts of VA patients for CHF, COPD, or diabetes; the sensitivity was 100%.[75] Among Medicare hip fracture patients, by contrast, Keeler et al. confirmed 88% of reported PE cases, and failed to ascertain just 6 cases (65% sensitivity) using ICD-9-CM codes.[76] For DVT, they found just 1 of 6 cases using ICD-9-CM codes (but no false positive codes). Other studies have demonstrated that ICD-9-CM codes for DVT and PE have high predictive value when listed as the principal diagnosis for readmissions after major orthopedic surgery (100%) or after inferior vena cava filter

[75] Geraci JM, Ashton CM, Kuykendall DH, Johnson ML, Wu L. In-hospital complications among survivors of admission for congestive heart failure, chronic obstructive pulmonary disease, or diabetes mellitus. J Gen Intern Med 1995;10(6):307-14.

[76] Keeler E, Kahn K, Bentow S. Assessing quality of care for hospitalized Medicare patients with hip fracture using coded diagnoses from the Medicare Provider Analysis and Review File. Springfield, VA: NTIS;1991.

placement (98%).[77] However, these findings do not directly address the validity of DVT/PE as a secondary diagnosis among patients treated by anticoagulation.

Construct validity. Explicit process of care failures in the CSP validation study were relatively frequent among both major surgical and medical cases with CSP 22 (72% and 69%, respectively), after disqualifying cases in which DVT/PE was actually present at admission.[78] Needleman and Buerhaus found that nurse staffing was independent of the occurrence of DVT/PE among both major surgical or medical patients.[79] However, Kovner and Gergen reported that having more registered nurse hours and non-RN hours was associated with a lower rate of DVT/PE after major surgery.[80]

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Postoperative PE or DVT generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is moderately high, relative to other indicators, at 72.6%, suggesting that observed differences in risk-adjusted rates likely reflect true differences across hospitals.

The signal standard deviation for this indicator is lower than many indicators, at 0.00633, indicating that the systematic differences (signal) among hospitals is low and less likely associated with hospital characteristics. The signal share is lower than many indicators, at 0.00511. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The project team assessed the effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals compared to no risk adjustment. They measured (1) the impact of adjustment on the assessment of relative hospital performance, (2) the relative importance of the adjustment, (3) the impact on hospitals with the highest and lowest rates, and (4) the impact throughout the distribution. The detected bias for Postoperative PE or DVT is high, indicating that the measures likely are biased based on the characteristics observed. (It is possible that characteristics that are not observed using administrative data may be related to the patient's risk of experiencing an adverse event.) Risk adjustment is important for this indicator.

Source

This indicator was originally proposed by Iezzoni et al. as part of the Complications Screening Program (CSP 22, "venous thrombosis and pulmonary embolism")[81] and was one of AHRQ's original HCUP Quality Indicators for major surgery and invasive vascular procedure patients.[82] A code that maps to this indicator in the final AHRQ PSI was proposed by Miller et al. as one component of a broader indicator ("iatrogenic conditions").[83]

[77] White RH, Romano P, Zhou H, Rodrigo J, Barger W. Incidence and time course of thromboembolic outcomes following total hip or knee arthroplasty. Arch Intern Med 1998;158(14):1525-31.

[78] Iezzoni LI, Davis RB, Palmer RH, Cahalane M, Hamel MB, Mukamal K, et al. Does the Complications Screening Program flag cases with process of care problems? Using explicit criteria to judge processes. Int J Qual Health Care 1999;11(2):107-18.

[79] Needleman J, Buerhaus PI, Mattke S, Stewart M, Zelevinsky K. Nurse Staffing and Patient Outcomes in Hospitals. Boston, MA: Health Resources Services Administration; 2001 February 28. Report No.:230-99-0021.

[80] Kovner C, Gergen PH. Nurse staffing levels and adverse events following surgery in U.S. hospitals. Image J Nurs Sch 1998;30(4):315-21.

[81] Iezzoni LI, Daley J, Heeren T, Foley SM, Fisher ES, Duncan C, et al. Identifying complications of care using administrative data. Med Care 1994;32(7):700-15.

[82] Johantgen M, Elixhauser A, Bali JK, Goldfarb M, Harris DR. Quality indicators using hospital discharge data: State and national applications. Jt Comm J Qual Improv 1998;24(2):88-195. Published erratum appears in Jt Comm J Qual Improv 1998;24(6):341.

[83] Miller M, Elixhauser A, Zhan C, Meyer G. Patient safety indicators: Using administrative data to identify potential patient safety concerns. Health Services Research 2001;36(6 Part II):110-132.

Postoperative Respiratory Failure

Definition	Cases of acute respiratory failure per 1,000 elective surgical discharges.
Numerator	Discharges with ICD-9-CM codes for acute respiratory failure (518.81) in any secondary diagnosis field per 1,000 discharges (After 1999, include 51884).
Denominator	All elective surgical discharges defined by admit type. Exclude patients with respiratory or circulatory diseases (MDC 4 and MDC 5). Exclude obstetrical patients in MDC 14.
Type of Indicator	Hospital level
Empirical Performance	Rate: 3.64 per 1,000 population at risk Bias: Substantial bias; should be risk-adjusted
Risk Adjustment	Age, sex, DRG, comorbidity categories

Summary

This indicator is intended to flag cases of postoperative respiratory failure. This indicator limits the code for respiratory failure to secondary diagnosis codes to eliminate respiratory failure that was present on admission. It further excludes patients who have major respiratory or circulatory disorders and limits the population at risk to elective surgery patients.

Panel Review

Panelists rated the overall usefulness of this indicator as relatively favorable. They felt that only acute respiratory failure should be retained in this indicator and noted that this clinically significant event is at least partially preventable.

Literature Review

Coding Validity. CSP 3 had a relatively high confirmation rate among major surgical cases in the FY1994 Medicare inpatient claims files from California and Connecticut (72% by coders' review, 75% by physicians' review).[84] [85] Nurse reviews were not performed.

Geraci et al. confirmed 1 of 2 episodes of respiratory failure reported on discharge abstracts of VA patients hospitalized for CHF or diabetes; the sensitivity for respiratory decompensation requiring mechanical ventilation was 25%.[86]

Construct Validity. Explicit process of care failures in the CSP validation study were slightly but not significantly more frequent among major surgical cases with CSP 3 than among unflagged controls (52% versus 46%).[87] Indeed, cases flagged on this indicator were significantly less likely than unflagged controls (24% versus 64%) to have at least one of four specific process-of-care problems in the earlier study of

[84] Lawthers a, McCarthy E, Davis R, Peterson L, Palmer R, Iezzoni L. Identification of in-hospital complications from claims data: is it valid? Med Care 2000;38(8):785-795.

[85] Weingart SN, Iezzoni LI, Davis RB, Palmer RH, Cahalane M, Hamel MB, et al. Use of administrative data to find substandard care: Validation of the Complications Screening Program. Med Care 2000;38(8):796-806.

[86] Geraci JM, Ashton CM, Kuykendall DH, Johnson ML, Wu L. In-hospital complications among survivors of admission for congestive heart failure, chronic obstructive pulmonary disease, or diabetes mellitus. J Gen Intern Med 1995;10(6):307-14.

[87] Iezzoni LI, Davis RB, Palmer RH, Cahalane M, Hamel MB, Mukamal K, et al. Does the Complications Screening Program flag cases with process of care problems? Using explicit criteria to judge processes. Int J Qual Health Care 1999;11(2):107-18.

elderly Medicare beneficiaries.[88]

Needleman and Buerhaus found that nurse staffing was independent of the occurrence of pulmonary failure among major surgery patients.[89] However, Kovner and Gergen reported that having more registered nurse hours per adjusted patient day was associated with a lower rate of "pulmonary compromise" after major surgery.[90]

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Postoperative respiratory failure generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is lower than many indicators, at 46.6%, suggesting that observed differences in risk-adjusted rates may not reflect true differences across hospitals.

The signal standard deviation for this indicator is lower than many indicators, at 0.00230, indicating that the systematic differences (signal) among hospitals is low and less likely associated with hospital characteristics. The signal share is lower than many indicators, at 0.00187. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The project team assessed the effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals compared to no risk adjustment. They measured (1) the impact of adjustment on the assessment of relative hospital performance, (2) the relative importance of the adjustment, (3) the impact on hospitals with the highest and lowest rates, and (4) the impact throughout the distribution. The detected bias for Postoperative respiratory failure is high, indicating that the measures likely are biased based on the characteristics observed. (It is possible that characteristics that are not observed using administrative data may be related to the patient's risk of experiencing an adverse event.) Risk adjustment is important for this indicator.

Source

This indicator was originally proposed by Iezzoni et al. as part of the CSP (CSP 3, "postoperative pulmonary compromise").[91] Their definition also includes pulmonary congestion, other (or postoperative) pulmonary insufficiency, and acute pulmonary edema, which were omitted from this PSI. The University HealthSystem Consortium (#2927) and AHRQ's original HCUP Quality Indicators adopted the CSP indicator for major surgery patients.[92] Needleman and Buerhaus identified postoperative pulmonary failure as an "Outcome Potentially Sensitive to Nursing," using the original CSP definition.[93]

[88] Hawker GA, Coyte PC, Wright JG, Paul JE, Bombardier C. Accuracy of administrative data for assessing outcomes after knee replacement surgery. J. Clin Epidimiol 1997;50(3):265-73.

[89] Needleman J, Buerhaus PI, Mattke S, Stewart M, Zelevinsky K. Nurse Staffing and Patient Outcomes in Hospitals. Boston, MA: Health Resources Services Administration; 2001 February 28. Report No.:230-99-0021.

[90] Kovner C, Gergen PJ. Nurse staffing levels and adverse events following surgery in U.S. hospitals. Image J Nurs Sch 1998;30(4):315-21.

[91] Iezzoni LI, Daley J, Heeren T, Foley SM, Fisher ES, Duncan C, et al. Identifying complications of care using administrative data. Med Care 1994;32(7):700-15.

[92] Johantgen M, Elixhauser A, Bali JK, Goldfarb M, Harris DR. Quality indicators using hospital discharge data: State and national applications. Jt Comm J Qual Improv 1998;24(2):88-195. Published erratum appears in Jt Comm J Qual Improv 1998;24(6):341.

[93] Needleman et al. 2001.

Postoperative Sepsis

Definition	Cases of sepsis per 1,000 elective surgery patients, with length of stay more than 3 days.
Numerator	Discharges with ICD-9-CM code for sepsis in any secondary diagnosis field per 1,000 elective surgical discharge.
Denominator	All elective surgical discharges defined by admit type. Exclude patients with a principal diagnosis of infection, any code for immunocompromised state, or cancer. Include only patients with a length of stay of 4 days or more. Exclude obstetrical patients in MDC 14.
Type of Indicator	Hospital level
Empirical Performance	Rate: 10.1 per 1,000 population at risk Bias: Substantial bias; should be risk-adjusted
Risk Adjustment	Age, sex, DRG, comorbidity categories

Summary

This indicator is intended to flag cases of nosocomial postoperative sepsis. This indicator limits the code for sepsis to secondary diagnosis codes to eliminate sepsis that was present on admission. This indicator also excludes patients who have a principal diagnosis of infection, patients with a length of stay of less than 3 days, and patients with potential immunocompromised states (e.g., AIDS, cancer, transplant).

Panel Review

Panelists rated the overall usefulness of this indicator favorably, although they were less sure that this complication was reflective of medical error.

This indicator includes pediatric patients. High-risk neonates are at particularly high risk for catheter-related infections.

Literature Review

Coding validity. No evidence on validity is available from CSP studies. Barbour reported that only 38% of discharge abstracts with a diagnosis of sepsis actually had hospital-acquired sepsis.[94] However, this review was not limited to cases with a secondary diagnosis of sepsis, and sensitivity could not be evaluated. Geraci et al. confirmed (by blood culture) only 2 of 15 episodes of sepsis or "other infection" reported on discharge abstracts of VA patients hospitalized for CHF, COPD, or diabetes; the sensitivity for a positive blood culture was 50%.[95] In comparison with the VA's National Surgical Quality Improvement Program database, in which "systemic sepsis" is defined by a positive blood culture and systemic manifestations of sepsis within 30 days after surgery, the ICD-9-CM diagnosis had a sensitivity of 37% and a predictive value of 30%.[96]

Construct validity. Needleman and Buerhaus found that nurse staffing was independent of the occurrence of sepsis among both major surgical

[94] Barbour GL. Usefulness of a discharge diagnosis of sepsis in detecting iatrogenic infection and quality of care problems. Am J Med Qual 1993;8(1):2-5.

[95] Geraci JM, Ashton CM, Kuykendall DH, Johnson ML, Wu L. In-hospital complications among survivors of admission for congestive heart failure, chronic obstructive pulmonary disease, or diabetes mellitus. J Gen Intern Med 1995;10(6):307-14.

[96] Best W, Khuri S, Phelan M, Hur K, Henderson W, Demakis J, et al. Identifying patient preoperative risk factors and postoperative adverse events in administrative databases: Results from the Department of Veterans Affairs national Surgical Quality Improvement Program. J Am Coll Surg 2002;194(3):257-266.

or medical patients.[97]

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Postoperative sepsis generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is lower than many indicators, at 53.9%, suggesting that observed differences in risk-adjusted rates may not reflect true differences across hospitals.

The signal standard deviation for this indicator is lower than many indicators, at 0.00869, indicating that the systematic differences (signal) among hospitals is low and less likely associated with hospital characteristics. The signal share is lower than many indicators, at 0.00790. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The project team assessed the effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals compared to no risk adjustment. They measured (1) the impact of adjustment on the assessment of relative hospital performance, (2) the relative importance of the adjustment, (3) the impact on hospitals with the highest and lowest rates, and (4) the impact throughout the distribution. The detected bias for Postoperative sepsis is high, indicating that the measures likely are biased based on the characteristics observed. (It is possible that characteristics that are not observed using administrative data may be related to the patient's risk of experiencing an adverse event.) Risk adjustment is important for this indicator.

Source

This indicator was originally proposed by Iezzoni et al. as part of the Complications Screening Program (CSP 7, "septicemia").[98] Needleman and Buerhaus identified sepsis as an "Outcome Potentially Sensitive to Nursing" using the same CSP definition.[99]

[97] Needleman J, Buerhaus PI, Mattke S, Stewart M, Zelevinsky K. Nurse Staffing and Patient Outcomes in Hospitals. Boston, MA: Health Resources Services Administration; 2001 February 28. Report No.:230-99-0021.

[98] Iezzoni LI, Daley J, Heeren T, Foley SM, Fisher ES, Duncan C, et al. Identifying complications of care using administrative data. Med Care 1994;32(7):700-15.

[99] Needleman et al., 2001.

Postoperative Wound Dehiscence

Hospital Level Definition

Definition	Cases of reclosure of postoperative disruption of abdominal wall per 1,000 cases of abdominopelvic surgery.
Numerator	Discharges with ICD-9-CM code for reclosure of postoperative disruption of abdominal wall (5461) in any secondary procedure field per 1,000 eligible discharges.
Denominator	All abdominopelvic surgical discharges. Exclude obstetrical patients in MDC 14.
Type of Indicator	Hospital level
Empirical Performance	Rate: 1.95 per 1,000 population at risk Bias: Some bias demonstrated
Risk Adjustment	Age, sex, DRG, comorbidity categories

Postoperative Wound Dehiscence

Area Level Definition

Definition	Cases of reclosure of postoperative disruption of abdominal wall per 100,000 population.
Numerator	Discharges with ICD-9-CM code for reclosure of postoperative disruption of abdominal wall (5461) in any procedure field (principal or secondary) of abdominopelvic surgical discharges. Exclude obstetrical patients in MDC 14.
Denominator	Population of county or MSA associated with FIPS code of patient's residence or hospital location.
Type of Indicator	Area level
Empirical Performance	Rate: 1.36 per 100,000 population at risk
Risk Adjustment	No risk adjustment

Summary

This indicator is intended to flag cases of wound dehiscence in patients who have undergone abdominal and pelvic surgery. This indicator is defined both on a hospital level (by including cases based on secondary diagnosis associated with the same hospitalization) and on an area level (by including all cases of wound dehiscence).

Panel Review

Panelists suggested that postoperative wound disruption be excluded from the indicator and that trauma, cancer, and immunocompromised patients be included. They also reported that the risk of developing wound dehiscence varies with patient factors such as age and comorbidities.

Literature Review

Coding validity. No evidence on validity is available from CSP studies. Hawker et al. found that the sensitivity and predictive value of wound dehiscence were both 100%.[100] Faciszewski et al. aggregated wound dehiscence with postoperative hemorrhage or hematoma and reported a pooled confirmation rate of 17% with 3% sensitivity of coding among patients who underwent spinal fusion.[101] In comparison with

[100] Hawker BA, Coyte PC, Wright JG, Paul JE, Bombardier C. Accuracy of administrative data for assessing outcomes after knee replacement surgery. J Clin Epidemiol 1997;50(3):265-73.

[101] Faciszewski T, Johnson L, Noren C, Smith MD.

the VA's National Surgical Quality Improvement Program database, in which dehiscence is defined as fascial disruption within 30 days after surgery, the ICD-9-CM diagnosis of wound disruption had a sensitivity of 25% and a predictive value of 23%.[102] This code (9983) was ultimately removed from the accepted PSI, because the clinical panel was concerned that the diagnosis definition was too broad and failed to distinguish skin from fascial separation.

Construct validity. Based on two-stage review of randomly selected deaths, Hannan et al. reported that cases with a secondary diagnosis of wound disruption were 3.0 times more likely to have received care that departed from professionally recognized standards than cases without that code (4.3% versus 1.7%), after adjusting for patient demographic, geographic, and hospital characteristics.[103]

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Postoperative wound dehiscence generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is related to systematic differences (signal) in hospital performance rather than random variation (noise)—is low, at 35.6%, suggesting that observed differences in risk-adjusted rates may not reflect true differences across hospitals.

The signal standard deviation for this indicator is lower than many indicators, at 0.00188, indicating that the systematic differences (signal) among hospitals is low and less likely associated with hospital characteristics. The signal share is lower than many indicators, at 0.00171. Signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The project team assessed the effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals compared to no risk adjustment. They measured (1) the impact of adjustment on the assessment of relative hospital performance, (2) the relative importance of the adjustment, (3) the impact on hospitals with the highest and lowest rates, and (4) the impact throughout the distribution. The detected bias for Postoperative wound dehiscence is moderate, indicating that the measures may or may not be substantially biased based on the characteristics observed.

Source

An indicator on this topic (9983) was originally proposed by Hannan et al. to target "cases that would have a higher percentage of quality of care problems than cases without the criterion, as judged by medical record review."[104] The same code was included within a broader indicator ("adverse events and iatrogenic complications") in AHRQ's original HCUP Quality Indicators.[105] Iezzoni et al. identified an associated procedure code for reclosure of an abdominal wall dehiscence (5461), and included both codes in the Complications Screening Program.[106] Miller et al. suggested the use of both codes (as "wound disruption") in the original "AHRQ PSI Algorithms and Groupings."[107]

Administrative databases' complication coding in anterior spinal fusion procedures. What does it mean? Spine 1995;20(16):1783-8.

[102] Best W, Khuri S, Phelan M, Hur K, Henderson W, Demakis J, et al. Identifying patient preoperative risk factors and postoperative adverse events in administrative databases: Results from the Department of Veterans Affairs national Surgical Quality Improvement Program. J Am Coll Surg 2002;194(3):257-266.

[103] Hannan EL, Bernard HR, O'Donnell JF, Kilburn H, Jr. A methodology for targeting hospital cases for quality of care record reviews. Am J Public Health 1989;79(4):430-6.

[104] Hannan et al., 1989.

[105] Johantgen M, Elixhauser A, Bali JK, Goldfarb M, Harris DR. Quality indicators using hospital discharge data: state and national applications. Jt Comm J Qual Improv 1998;24(2):88-195. Published erratum appears in Jt Comm J Qual Improv 1998;24(6):341.

[106] Iezzoni LI, Daley J, Heeren T, Foley SM, Fisher ES, Duncan C, et al. Identifying complications of care using administrative data. Med Care 1994;32(7):700-15.

[107] Miller M, Elixhauser A, Zhan C, Meyer G, Patient Safety Indicators: Using administrative data to identify potential patient safety concerns. Health Services Research 2001;36(6 Part II):110-132.

Accidental Puncture or Laceration

Hospital Level Definition

Definition	Cases of technical difficulty (e.g., accidental cut or laceration during procedure) per 1,000 discharges.
Numerator	Discharges with ICD-9-CM code denoting technical difficulty (e.g., accidental cut, puncture, perforation, or laceration) in any secondary diagnosis field per 1,000 discharges.
Denominator	All medical and surgical discharges defined by specific DRGs. Exclude obstetrical patients in MDC 14.
Type of Indicator	Hospital level
Empirical Performance	Rate: 3.29 per 1,000 population at risk Bias: Substantial bias; should be risk-adjusted
Risk Adjustment	Age, sex, DRG, comorbidity categories

Accidental Puncture or Laceration

Area Level Definition

Definition	Cases of technical difficulty (e.g., accidental cut or laceration during procedure) per 100,000 population.
Numerator	Discharges with ICD-9-CM code denoting technical difficulty (e.g., accidental cut, puncture, perforation, or laceration) in any diagnosis field (principal or secondary)
Denominator	Population of county or MSA associated with FIPS code of patient's residence or hospital location.
Type of Indicator	Area level
Empirical Performance	Rate: 31.17 per 100,000 population at risk
Risk Adjustment	No risk adjustment

Summary

This indicator is intended to flag cases of complications that arise due to technical difficulties in medical care—specifically, those involving an accidental puncture or laceration.

Panel Review

Panelists were unsure about how the culture of quality improvement in a hospital would affect the coding of this complication. Some physicians may be reluctant to record the occurrence of this complication for fear of punishment. Panelists also noted that some of these occurrences are not preventable.

Literature Review

Coding validity. No evidence on validity is available from CSP studies. A study of laparoscopic cholecystectomy found that 95% of patients with an ICD-9 code of accidental puncture or laceration had a confirmed injury to the bile duct or gallbladder.[108] However, only 27% had a clinically significant injury that required any intervention; sensitivity of reporting was not evaluated. A similar study of cholecystectomies reported that these two ICD-9 codes had a sensitivity of 40% and a predictive

[108] Taylor B. Common bile duct injury during laparoscopic cholecystectomy in Ontario: Does ICD-9 coding indicate true incidence? CMAJ 1998;158(4):481-5.

value of 23% in identifying bile duct injuries.[109] Among 185 total knee replacement patients, Hawker et al. found that the sensitivity and predictive value of codes describing "miscellaneous mishaps during or as a direct result of surgery" (definition not given) were 86% and 55%, respectively.[110] Romano et al. identified 19 of 45 episodes of accidental puncture, laceration, or related procedure using discharge abstracts of diskectomy patients; there was one false positive.[111]

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Accidental puncture or laceration generally performs well on several different dimensions, including reliability, bias, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is moderately high, relative to other indicators, at 82.9%, suggesting that observed differences in risk-adjusted rates most likely reflect true differences across hospitals.

The signal standard deviation for this indicator is lower than many indicators, at 0.00279, indicating that the systematic differences (signal) among hospitals is low and less likely associated with hospital characteristics. The signal share is lower than many indicators, at 0.00241. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The project team assessed the effect of age, gender, DRG, and comorbidity risk adjustment on the relative ranking of hospitals compared to no risk adjustment. They measured (1) the impact of adjustment on the assessment of relative hospital performance, (2) the relative importance of the adjustment, (3) the impact on hospitals with the highest and lowest rates, and (4) the impact throughout the distribution. The detected bias for Accidental puncture or laceration is high, indicating that the measures likely are biased based on the characteristics observed. (It is possible that characteristics that are not observed using administrative data may be related to the patient's risk of experiencing an adverse event.) Risk adjustment is important for this indicator.

Source

This indicator was originally proposed by Iezzoni et al. as part of the Complications Screening Program, although unlike the final PSI, its codes were split between two CSP indicators (CSP 27, "technical difficulty with medical care," and "sentinel events").[112] It was also included as one component of a broader indicator ("adverse events and iatrogenic complications") in AHRQ's original HCUP Quality Indicators.[113] The University HealthSystem Consortium adopted CSP 27 as an indicator for medical (#2806) and major surgery (#2956) patients. Miller et al. also split this set of ICD-9-CM codes into two broader indicators ("miscellaneous misadventures" and "E codes") in the original "AHRQ PSI Algorithms and Groupings."[114] Based on expert consensus panels, McKesson Health Solutions included one component of this PSI (Accidental Puncture or Laceration) in its CareEnhance Resource Management Systems, Quality Profiler Complications Measures Module.

[109] Valinsky LJ, Hockey RI, Hobbs MS, Fletcher DR, Pikora TJ, Parsons RW, et al. Finding bile duct injuries using record linkage: A validated study of complications following cholecystectomy. J Clin Epidemiol 1999;52(9):893-901.

[110] Hawker GA, Coyte PC, Wright JG, Paul JE, Bombardier C. Accuracy of administrative data for assessing outcomes after knee replacement surgery. J Clin Epidemiol 1997;50(3):265-73.

[111] Romano P. Can administrative data be used to ascertain clinically significant postoperative complications. American Journal of Medical Quality Press.

[112] Iezzoni LI, Daley J, Heeren T, Foley SM, Fisher ES, Duncan C, et al. Identifying complications of care using administrative data. Med Care 1994;32(7):700-15.

[113] Johantgen M, Elixhauser A, Bali JK, Goldfarb M, Harris DR. Quality indicators using hospital discharge data: State and national applications. Jt Comm J Qual Improv 1998;24(2):88-195. Published erratum appears in Jt Comm J Qual Improv 1998;24(6):341.

[114] Miller M, Elixhauser A, Zhan C, Meyer G, Patient Safety Indicators: Using administrative data to identify potential patient safety concerns. Health Services Research 2001;36(6 Part II):110-132.

Transfusion Reaction

Hospital Level Definition

Definition	Cases of transfusion reaction per 1,000 discharges.
Numerator	Discharges with ICD-9-CM code for transfusion reaction in any secondary diagnosis field per 1,000 discharges.
Denominator	All medical and surgical discharges defined by specific DRGs.
Type of Indicator	Hospital level Area level
Empirical Performance	Rate: 0.01 per 1,000 population at risk Bias: Did not undergo empirical testing of bias
Risk Adjustment	No risk adjustment

Transfusion Reaction

Area Level Definition

Definition	Cases of transfusion reaction per 100,000 population.
Numerator	Discharges with ICD-9-CM code for transfusion reaction in any diagnosis field (principal or secondary) of all medical and surgical discharges defined by specific DRGs.
Denominator	Population of county or MSA associated with FIPS code of patient's residence or hospital location.
Type of Indicator	Area level
Empirical Performance	Rate: 0.05 per 100,000 population
Risk Adjustment	No risk adjustment

Summary

This indicator is intended to flag cases of major reactions due to transfusions (ABO and Rh). This indicator is defined both on a hospital level (by including cases based on secondary diagnosis associated with the same hospitalization) and on an area level (by including all cases of transfusion reactions).

Panel Review

The overall usefulness of this indicator was rated as very favorable by panelists. This indicator includes only those events that result in additional medical care. Some minor reactions may be missed, although the panel suggested that these minor reactions are less clearly due to medical error than the Rh or ABO reactions included in the indicator.

Literature Review

The project team was unable to find evidence on validity from prior studies, most likely because this complication is quite rare.

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Given the low rates or occurrences for Transfusion reaction, the project team did not measure reliability or minimum bias. The indicator could not be risk-adjusted due to the small number of numerator cases. Users of the PSI software should note the output will only contain observed rates for Transfusion reaction.

Source

This indicator was originally proposed by Iezzoni

et al. as part of the Complications Screening Program (CSP "sentinel events").[115] It was also included as one component of a broader indicator ("adverse events and iatrogenic complications") in AHRQ's original HCUP Quality Indicators.[116] It was proposed by Miller et al. in the original "AHRQ PSI Algorithms and Groupings."[117]

[115] Iezzoni LI, Daley J, Heeren T, Foley SM, Fisher ES, Duncan C, et al. Identifying complications of care using administrative data. Med Care 1994;32(7):700-15.

[116] Johantgen M, Elixhauser A, Bali JK, Goldfarb M, Harris DR. Quality indicators using hospital discharge data: State and national applications. Jt Comm J Qual Improv 1998;24(2):88-195. Published erratum appears in Jt Comm J Qual Improv 1998;24(6):341.

[117] Miller M, Elixhauser A, Zhan C, Meyer G, Patient safety indicators: Using administrative data to identify potential patient safety concerns. Health Services Research 2001;36(6 Part II):110-132.

Birth Trauma—Injury to Neonate

Definition	Cases of birth trauma per 1,000 liveborn births.
Numerator	Discharges with ICD-9-CM code for birth trauma in any diagnosis field per 1,000 liveborn births.
Denominator	All liveborn births. Exclude infants with a subdural or cerebral hemorrhage (subgroup of birth trauma coding) and any diagnosis code of pre-term infant (denoting birth weight of less than 2,500 grams and less than 37 weeks gestation or 34 weeks gestation or less). Exclude infants with injury to skeleton (7673, 7674) and any diagnosis code of osteogenesis imperfecta (75651).
Type of Indicator	Hospital level
Empirical Performance	Rate: 6.34 per 1,000 population at risk Bias: Did not undergo empirical testing of bias
Risk Adjustment	Sex

Summary

This indicator is intended to flag cases of birth trauma for infants born alive in a hospital. The indicator excludes patients born pre-term, as birth trauma in these patients may be less preventable than for full-term infants.

Panel Review

The overall usefulness of this indicator was rated as favorable by panelists

Literature Review

Coding validity. A study of newborns who had a discharge diagnosis of birth trauma found that only 25% had sustained a significant injury to the head, neck, or shoulder.[118] The remaining patients either had superficial injuries or injuries inferior to the neck. The project team was unable to find other evidence on the validity of this indicator. Towner et al. linked California maternal and infant discharge abstracts from 1992 through 1994, but they used only infant discharge abstracts to describe the incidence of neonatal intracranial injury, and they did not report the extent of agreement between the two data sets.[119]

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Birth trauma generally performs well on several different dimensions, including reliability, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is high, relative to other indicators, at 97.0%, suggesting that observed differences in risk-adjusted rates reflect true differences across hospitals.

The signal standard deviation for this indicator is also high, relative to other indicators, at 0.04128, indicating that the systematic differences (signal) among hospitals is high and more likely associated with hospital characteristics. The signal share is also high, relative to other indicators, at 0.13603. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The

[118] Hughes C, Harley E, Milmoe G, Bala R, Martorella A. Birth trauma in the head and neck. Arch Otolaryngol Head Neck Surg 1999;125:193-199.

[119] Towner D, Castro MA, Eby-Wilkens E, Gilbert WM. Effect of mode of delivery in nulliparous women on neonatal intracranial injury. N Engl J Med 1999;341(23):1709-14.

lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The bias for Birth trauma was not measured, since adequate risk adjustment was not available..

Source

This indicator has been widely used in the obstetric community, although it is most commonly based on chart review rather than administrative data. It was proposed by Miller et al. in the original "AHRQ PSI Algorithms and Groupings."[120] Based on expert consensus panels, McKesson Health Solutions included a broader version of this indicator in its CareEnhance Resource Management Systems, Quality Profiler Complications Measures Module.

[120] Miller M, Elixhauser A, Zhan C, Meyer G, Patient Safety Indicators: Using administrative data to identify potential patient safety concerns. Health Services Research 2001;36(6 Part II):110-132.

Obstetric Trauma—Cesarean Delivery

Definition	Cases of obstetric trauma (4th degree lacerations, other obstetric lacerations) per 1,000 Cesarean deliveries.
Numerator	Discharges with ICD-9-CM code for obstetric trauma in any diagnosis or procedure field per 1,000 Cesarean deliveries.
Denominator	All Cesarean delivery discharges.
Type of Indicator	Hospital level
Empirical Performance	Rate: 5.93 per 1,000 population at risk Bias: Did not undergo empirical testing of bias
Risk Adjustment	Age

Summary

This indicator is intended to flag cases of potentially preventable trauma during Cesarean delivery.

Panel Review

The overall usefulness of an Obstetric trauma indicator was rated as favorable by panelists. After initial review, the indicator was eventually split into three separate Obstetric trauma indicators: Vaginal delivery with instrument, Vaginal delivery without instrument, and Cesarean delivery.

Literature Review

Coding validity. In a stratified probability sample of vaginal and Cesarean deliveries, the weighted sensitivity and predictive value of coding for third- and fourth-degree lacerations and vulvar/perineal hematomas (based on either diagnosis or procedure codes) were 89% and 90%, respectively.[158] The authors did not report coding validity for third- and fourth-degree lacerations separately. The project team was unable to find other evidence on validity from prior studies.

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Obstetric trauma—Cesarean delivery generally performs well on several different dimensions, including reliability, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is lower than many indicators, at 45.9%, suggesting that observed differences in risk-adjusted rates may not reflect true differences across hospitals.

The signal standard deviation for this indicator is also lower than many indicators, at 0.00590, indicating that the systematic differences (signal) among hospitals is low and less likely associated with hospital characteristics. The signal share is lower than many indicators, at 0.00576. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The bias for Obstetric trauma—Cesarean delivery was not measured, since adequate risk adjustment was not available..

Source

An overlapping subset of this indicator (third- or fourth-degree perineal laceration) has been adopted by the Joint Commission for the Accreditation of Healthcare Organizations (JCAHO) as a core performance measure for "pregnancy and related conditions" (PR-25). Based on expert consensus panels, McKesson Health Solutions included the JCAHO indicator in its CareEnhance Resource Management Systems, Quality Profiler Complications

Measures Module. Fourth degree laceration, one of the codes mapped to this PSI, was included as one component of a broader indicator ("obstetrical complications") in AHRQ's original HCUP Quality Indicators.[121]

[121] Johantgen M, Elixhauser A, Bali JK, Goldfarb M, Harris DR. Quality indicators using hospital discharge data: State and national applications. Jt Comm J Qual Improv 1998;24(2):88-195. Published erratum appears in Jt Comm J Qual Improv 1998;24(6):341.

Obstetric Trauma—Vaginal Delivery with Instrument

Definition	Cases of obstetric trauma (4th degree lacerations, other obstetric lacerations) per 1,000 instrument-assisted vaginal deliveries.
Numerator	Discharges with ICD-9-CM code for obstetric trauma in any diagnosis or procedure field per 1,000 instrument-assisted vaginal deliveries.
Denominator	All vaginal delivery discharges with any procedure code for instrument-assisted delivery.
Type of Indicator	Hospital level
Empirical Performance	Rate: 235.7 per 1,000 population at risk Bias: Did not undergo empirical testing of bias
Risk Adjustment	Age

Summary

This indicator is intended to flag cases of potentially preventable trauma during vaginal delivery with instrument.

Panel Review

The overall usefulness of an Obstetric trauma indicator was rated as favorable by panelists. After initial review, the indicator was eventually split into three separate Obstetric trauma indicators: Vaginal delivery with instrument, Vaginal delivery without instrument, and Cesarean delivery.

Literature Review

Coding validity. In a stratified probability sample of vaginal and Cesarean deliveries, the weighted sensitivity and predictive value of coding for third- and fourth-degree lacerations and vulvar/perineal hematomas (based on either diagnosis or procedure codes) were 89% and 90%, respectively.[158] The authors did not report coding validity for third- and fourth-degree lacerations separately. The project team was unable to find other evidence on validity from prior studies.

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Obstetric trauma—vaginal delivery with instrument generally performs well on several different dimensions, including reliability, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is moderately high, relative to other indicators, at 69.9%, suggesting that observed differences in risk-adjusted rates likely reflect true differences across hospitals.

The signal standard deviation for this indicator is also high, relative to other indicators, at 0.09794, indicating that the systematic differences (signal) among hospitals is high and more likely associated with hospital characteristics. The signal share is high, relative to other indicators, at 0.05539. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The bias for Obstetric trauma—vaginal delivery with instrument was not measured, since adequate risk adjustment was not available..

Source

An overlapping subset of this indicator (third- or fourth-degree perineal laceration) has been adopted by the Joint Commission for the Accreditation of Healthcare Organizations (JCAHO) as a core performance measure for "pregnancy and related conditions" (PR-25). Based on expert consensus panels, McKesson Health Solutions included the JCAHO indicator

in its CareEnhance Resource Management Systems, Quality Profiler Complications Measures Module. Fourth degree laceration, one of the codes mapped to this PSI, was included as one component of a broader indicator ("obstetrical complications") in AHRQ's original HCUP Quality Indicators.[122]

[122] Johantgen M, Elixhauser A, Bali JK, Goldfarb M, Harris DR. Quality indicators using hospital discharge data: State and national applications. Jt Comm J Qual Improv 1998;24(2):88-195. Published erratum appears in Jt Comm J Qual Improv 1998;24(6):341.

Obstetric Trauma—Vaginal Delivery without Instrument

Definition	Cases of obstetric trauma (4th degree lacerations, other obstetric lacerations) per 1,000 vaginal deliveries without instrument assistance.
Numerator	Discharges with ICD-9-CM code for obstetric trauma in any diagnosis or procedure field per 1,000 vaginal deliveries without instrument assistance.
Denominator	All vaginal delivery discharges. Exclude instrument-assisted delivery.
Type of Indicator	Hospital level
Empirical Performance	Rate: 85.1 per 1,000 population at risk Bias: Did not undergo empirical testing of bias
Risk Adjustment	Age

Summary

This indicator is intended to flag cases of potentially preventable trauma during a vaginal delivery without instrument.

Panel Review

The overall usefulness of an Obstetric trauma indicator was rated as favorable by panelists. After initial review, the indicator was split into three separate Obstetric trauma indicators: Vaginal delivery with instrument, Vaginal delivery without instrument, and Cesarean delivery.

Literature Review

Coding validity. In a stratified probability sample of vaginal and Cesarean deliveries, the weighted sensitivity and predictive value of coding for third- and fourth-degree lacerations and vulvar/perineal hematomas (based on either diagnosis or procedure codes) were 89% and 90%, respectively.[158] The authors did not report coding validity for third- and fourth-degree lacerations separately. The project team was unable to find other evidence on validity from prior studies.

Empirical Analysis

The project team conducted extensive empirical analyses on the PSIs. Obstetric trauma—vaginal delivery without instrument generally performs well on several different dimensions, including reliability, relatedness of indicators, and persistence over time.

Reliability. The signal ratio—measured by the proportion of the total variation across hospitals that is truly related to systematic differences (signal) in hospital performance rather than random variation (noise)—is high, relative to other indicators, at 86.4%, suggesting that observed differences in risk-adjusted rates reflect true differences across hospitals.

The signal standard deviation for this indicator is also high, relative to other indicators, at 0.04314, indicating that the systematic differences (signal) among hospitals is high and more likely associated with hospital characteristics. The signal share is lower than many other indicators, at 0.02470. The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

Minimum bias. The bias for Obstetric trauma—vaginal delivery without instrument was not measured, since adequate risk adjustment was not available.

Source

An overlapping subset of this indicator (third- or fourth-degree perineal laceration) has been adopted by the Joint Commission for the Accreditation of Healthcare Organizations (JCAHO) as a core performance measure for "pregnancy and related conditions" (PR-25).

Based on expert consensus panels, McKesson Health Solutions included the JCAHO indicator in its CareEnhance Resource Management Systems, Quality Profiler Complications Measures Module. Fourth-degree laceration, one of the codes mapped to this PSI, was included as one component of a broader indicator ("obstetrical complications") in AHRQ's original HCUP Quality Indicators.[123]

[123] Johantgen M, Elixhauser A, Bali JK, Goldfarb M, Harris DR. Quality indicators using hospital discharge data: State and national applications. Jt Comm J Qual Improv 1998;24(2):88-195. Published erratum appears in Jt Comm J Qual Improv 1998;24(6):341.

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Appendix A: Patient Safety Indicators – Detailed Definitions

Complications of Anesthesia

Numerator:

Discharges with ICD-9-CM diagnosis codes for anesthesia complications in any secondary diagnosis field per 1,000 discharges.

Anesthesia Complications
ICD-9-CM diagnosis codes:

E8763 Endotracheal tube wrongly place during anesthetic procedure
E8551 Accidental poisoning, Other nervous system depressants

Adverse effects in therapeutic use, other central nervous system depressants and anesthetics:
E9381 Halothane
E9382 Other gaseous anesthetics
E9383 Intravenous anesthetics
E9384 Other and unspecified general anesthetics
E9385 Surface and infiltration anesthetics
E9386 Peripheral nerve and plexus blocking anesthetics
E9387 Spinal anesthetics
E9389 Other and unspecified local anesthetics

Poisoning by other central nervous system depressants and anesthetics:
968.1 Halothane
968.2 Other gaseous anesthetics
968.3 Intravenous anesthetics
968.4 Other and unspecified general anesthetics
968.7 Spinal anesthetics

Denominator:

All surgical discharges defined by specific DRGs.

Surgical Discharges
DRGs:

001 Craniotomy, age greater than 17 except for trauma
002 Craniotomy for trauma, age greater than 17
003 Craniotomy, age 0-17
004 Spinal procedures
005 Extracranial vascular procedures
006 Carpal tunnel release
007 Peripheral and cranial nerve and other nervous system procedures with CC
008 Peripheral and cranial nerve and other nervous system procedures without CC
036 Retinal procedures
037 Orbital procedures
038 Primary iris procedures
039 Lens procedures with or without vitrectomy
040 Extraocular procedures except orbit, age greater than 17
041 Extraocular procedures except orbit, age 0-17
042 Intraocular procedures except retina, iris and lens
049 Major head and neck procedures
050 Sialoadenectomy
051 Salivary gland procedures except sialoadenectomy
052 Cleft lip and palate repair
053 Sinus and mastoid procedures, age greater than 17

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054 Sinus and mastoid procedures, age 0-17
055 Miscellaneous ear, nose, mouth and throat procedures
056 Rhinoplasty
057 Tonsillectomy and adenoidectomy procedures except tonsillectomy and/or adenoidectomy only, age greater than 17
058 Tonsillectomy and adenoidectomy procedures except tonsillectomy and/or adenoidectomy only, age 0-17
059 Tonsillectomy and/or adenoidectomy only, age greater than 17
060 Tonsillectomy and/or adenoidectomy only, age 0 - 17
061 Myringotomy with tube insertion, age greater than 17
062 Myringotomy with tube insertion, age 0-17
063 Other ear, nose, mouth and throat OR procedures
075 Major chest procedures
076 Other respiratory system OR procedures with CC
077 Other respiratory system OR procedures without CC
103 Heart transplant
104 Cardiac valve and other major cardiothoracic procedures with cardiac catheterization
105 Cardiac valve and other major cardiothoracic procedures without cardiac catheterization
106 Coronary bypass with PTCA
107 Coronary bypass with cardiac catheterization
108 Other cardiothoracic procedures
109 Coronary bypass without cardiac catheterization
110 Major cardiovascular procedures with CC
111 Major cardiovascular procedures without CC
112 Percutaneous cardiovascular procedures
113 Amputation for circulatory system disorders except upper limb and toe
114 Upper limb and toe amputation for circulatory site
115 Permanent cardiac pacemaker implant with acute myocardial infarction, heart failure or shock or AICD lead or generator procedure
116 Other permanent cardiac pacemaker implant or PTCA with coronary arterial stent
117 Cardiac pacemaker revision except device replacement
118 Cardiac pacemaker device replacement
119 Vein ligation and stripping
120 Other circulatory system OR procedures
146 Rectal resection with CC
147 Rectal resection without CC
148 Major small and large bowel procedures with CC
149 Major small and large bowel procedures without CC
150 Peritoneal adhesiolysis with CC
151 Peritoneal adhesiolysis without CC
152 Minor small and large bowel procedures with CC
153 Minor small and large bowel procedures without CC
154 Stomach, esophageal and duodenal procedures, age greater than 17 with CC
155 Stomach, esophageal and duodenal procedures, age greater than 17 without CC
156 Stomach, esophageal and duodenal procedures, age 0-17
157 Anal and stomal procedures with CC
158 Anal and stomal procedures without CC
159 Hernia procedures except inguinal and femoral, age greater than 17 with CC
160 Hernia procedures except inguinal and femoral, age greater than 17 without CC
161 Inguinal and femoral hernia procedures, age greater than 17 with CC
162 Inguinal and femoral hernia procedures, age greater than 17 without CC
163 Hernia procedures, age 0-17
164 Appendectomy with complicated principal diagnosis with CC
165 Appendectomy with complicated principal diagnosis without CC
166 Appendectomy without complicated principal diagnosis with CC
167 Appendectomy without complicated principal diagnosis without CC
168 Mouth procedures with CC
169 Mouth procedures without CC
170 Other digestive system OR procedures with CC
171 Other digestive system OR procedures without CC
191 Pancreas, liver and shunt procedures with CC
192 Pancreas, liver and shunt procedures without CC
193 Biliary tract procedures except only cholecystectomy with or without common duct exploration with CC

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194	Biliary tract procedures except only cholecystectomy with or without common duct exploration without CC
195	Cholecystectomy with common duct exploration with CC
196	Cholecystectomy with common duct exploration without CC
197	Cholecystectomy except by laparoscope without common duct exploration with CC
198	Cholecystectomy except by laparoscope without common duct exploration without CC
199	Hepatobiliary diagnostic procedure for malignancy
200	Hepatobiliary diagnostic procedure for nonmalignancy
201	Other hepatobiliary or pancreas OR procedures
209	Major joint and limb reattachment procedures of lower extremity
210	Hip and femur procedures except major joint procedures, age greater than 17 with CC
211	Hip and femur procedures except major joint procedures, age greater than 17 without CC
212	Hip and femur procedures except major joint procedure, age 0-17
213	Amputation for musculoskeletal system and connective tissue disorders
214	No longer valid
215	No longer valid
216	Biopsies of musculoskeletal system and connective tissue
217	Wound debridement and skin graft except hand for musculoskeletal and connective tissue disorders
218	Lower extremity and humerus procedures except hip, foot and femur, age greater than 17 with CC
219	Lower extremity and humerus procedures except hip, foot and femur, age greater than 17 without CC
220	Lower extremity and humerus procedures except hip, foot and femur, age 0-17
221	No longer valid
222	No longer valid
223	Major shoulder/elbow procedures or other upper extremity procedures with CC
224	Shoulder, elbow or forearm procedures except major joint procedures without CC
225	Foot procedures
226	Soft tissue procedures with CC
227	Soft tissue procedures without CC
228	Major thumb or joint procedures or other hand or wrist procedures with CC
229	Hand or wrist procedures except major joint procedures without CC
230	Local excision and removal of internal fixation devices of hip and femur
231	Local excision and removal of internal fixation devices except hip and femur
232	Arthroscopy
233	Other musculoskeletal system and connective tissue OR procedures with CC
234	Other musculoskeletal system and connective tissue OR procedures without CC
257	Total mastectomy for malignancy with CC
258	Total mastectomy for malignancy without CC
259	Subtotal mastectomy for malignancy with CC
260	Subtotal mastectomy for malignancy without CC
261	Breast procedure for nonmalignancy except biopsy and local excision
262	Breast biopsy and local excision for nonmalignancy
263	Skin graft and/or debridement for skin ulcer or cellulitis with CC
264	Skin graft and/or debridement for skin ulcer or cellulitis without CC
265	Skin graft and/or debridement except for skin ulcer or cellulitis with CC
266	Skin graft and/or debridement except for skin ulcer or cellulitis without CC
267	Perianal and pilonidal procedures
268	Skin, subcutaneous tissue and breast plastic procedures
269	Other skin, subcutaneous tissue and breast procedures with CC
270	Other skin, subcutaneous tissue and breast procedures without CC
285	Amputation of lower limb for endocrine, nutritional and metabolic disorders
286	Adrenal and pituitary procedures
287	Skin grafts and wound debridements for endocrine, nutritional and metabolic disorders
288	OR procedures for obesity
289	Parathyroid procedures
290	Thyroid procedures
291	Thyroglossal procedures
292	Other endocrine, nutritional and metabolic OR procedures with CC
293	Other endocrine, nutritional and metabolic OR procedures without CC
302	Kidney transplant
303	Kidney, ureter and major bladder procedures for neoplasm
304	Kidney, ureter and major bladder procedures for nonneoplasms with CC
305	Kidney, ureter and major bladder procedures for nonneoplasms without CC
306	Prostatectomy with CC

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307 Prostatectomy without CC
308 Minor bladder procedures with CC
309 Minor bladder procedures without CC
310 Transurethral procedures with CC
311 Transurethral procedures without CC
312 Urethral procedures, age greater than 17 with CC
313 Urethral procedures, age greater than 17 without CC
314 Urethral procedures, age 0-17
315 Other kidney and urinary tract OR procedures
334 Major male pelvic procedures with CC
335 Major male pelvic procedures without CC
336 Transurethral prostatectomy with CC
337 Transurethral prostatectomy without CC
338 Testes procedures for malignancy
339 Testes procedures for nonmalignancy, age greater than 17
340 Testes procedures for nonmalignancy, age 0-17
341 Penis procedures
342 Circumcision, age greater than 17
343 Circumcision, age 0-17
344 Other male reproductive system OR procedures for malignancy
345 Other male reproductive system OR procedures except for malignancy
353 Pelvic evisceration, radical hysterectomy and radical vulvectomy
354 Uterine and adnexa procedures for nonovarian/adnexal malignancy with CC
355 Uterine and adnexa procedures for nonovarian/adnexa procedures without CC
356 Female reproductive system reconstructive procedures
357 Uterine and adnexa procedures for ovarian or adnexal malignancy
358 Uterine and adnexa procedures for nonmalignancy with CC
359 Uterine and adnexa procedures for nonmalignancy without CC
360 Vagina, cervix and vulva procedures
361 Laparoscopy and incisional tubal interruption
362 Endoscopic tubal interruption
363 D and C, conization and radioimplant for malignancy
364 D and C, conization except for malignancy
365 Other female reproductive system OR procedures
370 Cesarean section with CC
371 Cesarean section without CC
374 Vaginal delivery with sterilization and/or D and C
375 Vaginal delivery with OR procedure except sterilization and/or D and C
377 Postpartum and postabortion diagnoses with OR procedure
381 Abortion with D and C aspiration curettage or hysterectomy
392 Splenectomy, age greater than 17
393 Splenectomy, age 0-17
394 Other OR procedures of the blood and blood-forming organs
400 Lymphoma and leukemia with major OR procedures
401 Lymphoma and nonacute leukemia with other OR procedure with CC
402 Lymphoma and nonacute leukemia with other OR procedure without CC
406 Myeloproliferative disorders or poorly differentiated neoplasms with major OR procedures with CC
407 Myeloproliferative disorders or poorly differentiated neoplasms with major OR procedures without CC
408 Myeloproliferative disorders or poorly differentiated neoplasms with other OR procedures
415 OR procedure for infectious and parasitic diseases
424 OR procedures with principal diagnosis of mental illness
439 Skin grafts for injuries
440 Wound debridements for injuries
441 Hand procedures for injuries
442 Other OR procedures for injuries with CC
443 Other OR procedures for injuries without CC
458 No longer valid
459 No longer valid
461 OR procedures with diagnoses of other contact with health services
468 Extensive OR procedure unrelated to principal diagnosis
471 Bilateral or multiple major joint procedures of lower extremity
472 No longer valid

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476 Prostatic OR procedure unrelated to principal diagnosis
477 Nonextensive OR procedure unrelated to principal diagnosis
478 Other vascular procedures with CC
479 Other vascular procedures without CC
480 Liver transplant
481 Bone marrow transplant
482 Tracheostomy for face, mouth and neck diagnoses
483 Tracheostomy except for face, mouth and neck diagnoses
484 Craniotomy for multiple significant trauma
485 Limb reattachment, hip and femur procedures for multiple significant trauma
486 Other OR procedures for multiple significant trauma
488 HIV with extensive OR procedure
491 Major joint and limb reattachment procedures of upper extremity
493 Laparoscopic cholecystectomy without common duct exploration with CC
494 Laparoscopic cholecystectomy without common duct exploration without CC
495 Lung transplant
496 Combined anterior/posterior spinal fusion
497 Spinal fusion with CC
498 Spinal fusion without CC
499 Back and neck procedures except spinal fusion with CC
500 Back and neck procedures except spinal fusion without CC
501 Knee procedures with principal diagnosis of infection, with CC
502 Knee procedures with principal diagnosis of infection, without CC
503 Knee procedures without principal diagnosis of infection
504 Extensive 3rd degree burns with skin graft
506 Full thickness burn with skin graft or inhalation injury with CC or significant trauma
507 Full thickness burn with skin graft or inhalation injury without CC or significant trauma
512 Simultaneous pancreas/kidney transplant
513 Pancreas transplant
514 Cardiac defibrillator implant with cardiac catheterization
515 Cardiac defibrillator implant without cardiac catheterization
516 Percutaneous cardiovascular procedure with AMI
517 Percutaneous cardiovascular procedure with non-drug eluting stent without AMI
518 Percutaneous cardiovascular procedure without coronary artery stent or AMI
519 Cervical spinal fusion with CC
520 Cervical spinal fusion without CC
525 Heart assist system implant
526 Percutaneous cardiovascular procedure with drug eluting stent with AMI
527 Percutaneous cardiovascular procedure with drug eluting stent without AMI

Exclude:

Patients with codes for poisoning due to anesthetics (E8551, 9681-4, 9687) and any diagnosis code for active drug dependence, active nondependent abuse of drugs, or self-inflicted injury.

Active Drug Dependence
ICD-9-CM diagnosis codes:

30400 Opioid type dependence - unspecified
30401 Opioid type dependence - continuous
30402 Opioid type dependence - episodic
30410 Barbiturate and similarly acting sedative or hypnotic dependence - unspecified
30411 Barbiturate and similarly acting sedative or hypnotic dependence - continuous
30412 Barbiturate and similarly acting sedative or hypnotic dependence - episodic
30420 Cocaine dependence - unspecified
30421 Cocaine dependence - continuous
30422 Cocaine dependence - episodic
30430 Cannabis dependence - unspecified
30431 Cannabis dependence - continuous
30432 Cannabis dependence - episodic
30440 Amphetamine and other psycho stimulant dependence - unspecified

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30441 Amphetamine and other psycho stimulant dependence - continuous
30442 Amphetamine and other psycho stimulant dependence - episodic
30450 Hallucinogen dependence - unspecified
30451 Hallucinogen dependence - continuous
30452 Hallucinogen dependence - episodic
30460 Other specified drug dependence - unspecified
30461 Other specified drug dependence - continuous
30462 Other specified drug dependence - episodic
30470 Combinations of opioid type drug with any other - unspecified
30471 Combinations of opioid type drug with any other - continuous
30472 Combinations of opioid type drug with any other - episodic
30480 Combinations of drug excluding opioid type drug - unspecified
30481 Combinations of drug excluding opioid type drug - continuous
30482 Combinations of drug excluding opioid type drug - episodic
30490 Unspecified drug dependence - unspecified
30491 Unspecified drug dependence - continuous
30492 Unspecified drug dependence - episodic

Active Nondependent Abuse of Drugs

ICD-9-CM diagnosis codes:

30520 Cannabis abuse - unspecified
30521 Cannabis abuse - continuous
30522 Cannabis abuse - episodic
30530 Hallucinogen abuse - unspecified
30531 Hallucinogen abuse - continuous
30532 Hallucinogen abuse - episodic
30540 Barbiturate and similarly acting sedative or hypnotic abuse - unspecified
30541 Barbiturate and similarly acting sedative or hypnotic abuse - continuous
30542 Barbiturate and similarly acting sedative or hypnotic abuse - episodic
30550 Opioid abuse - unspecified
30551 Opioid abuse - continuous
30552 Opioid abuse - episodic
30560 Cocaine abuse - unspecified
30561 Cocaine abuse - continuous
30562 Cocaine abuse - episodic
30570 Amphetamine or related acting sympathomimetic abuse - unspecified
30571 Amphetamine or related acting sympathomimetic abuse - continuous
30572 Amphetamine or related acting sympathomimetic abuse - episodic
30580 Antidepressant type abuse - unspecified
30581 Antidepressant type abuse - continuous
30582 Antidepressant type abuse - episodic
30590 Other, mixed, or unspecified drug abuse - unspecified
30591 Other, mixed, or unspecified drug abuse - continuous
30592 Other, mixed, or unspecified drug abuse - episodic

Self-Inflicted Injury

ICD-9-CM diagnosis codes:

Suicide and self-inflicted poisoning by solid or liquid substance:

E9500 Analgesics, antipyretics, and antirheumatics
E9501 Barbiturates
E9502 Other sedative and hypnotics
E9503 Tranquilizers and other psychotropic agents
E9504 Other specified drugs and medicinal substances
E9505 Unspecified drug or medicinal substance
E9506 Agricultural and horticultural chemical and pharmaceutical preparations other than plant foods and fertilizers
E9507 Corrosive and caustic substances
E9508 Arsenic and its compounds
E9509 Other and unspecified solid and liquid substances

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Suicide and self-inflicted poisoning by gases in domestic use:
E9510 Gas distributed by pipeline
E9511 Liquefied petroleum gas distributed in mobile containers
E9518 Other utility gases

Suicide and self-inflicted poisoning by other gases and vapors:
E9520 Motor vehicle exhaust gas
E9521 Other carbon monoxide
E9528 Other specified gases and vapors
E9529 Unspecified gases and vapors

Suicide and self-inflicted injury by hanging, strangulation, and suffocation:
E9530 Hanging
E9531 Suffocation by plastic bag
E9538 Other specified means
E954 Suicide and self-inflicted injury by submersion [drowning]

Suicide and self-inflicted injury by firearms and explosives:
E9550 Handgun
E9551 Shotgun
E9552 Hunting rifle
E9553 Military firearms
E9554 Other and unspecified firearms
E9555 Explosives
E9559 Unspecified

E956 Suicide and self inflicted injury by cutting and piercing instrument

Suicide and self-inflicted injury by jumping from a high place:
E9570 Residential premises
E9571 Other man-made structures
E9572 Natural sites
E9579 Unspecified

Suicide and self-inflicted injury by other and unspecified means:
E9580 Jumping or lying before moving object
E9581 Burns, fire
E9582 Scald
E9583 Extremes of cold
E9584 Electrocution
E9585 Crashing of motor vehicle
E9586 Crashing of aircraft
E9587 Caustic substances except poisoning
E9588 Other specified means
E9589 Unspecified means

Death in Low-Mortality DRGs

Numerator:

All discharges with disposition of “deceased” per 1,000 population at risk.

Denominator:

All discharges in DRGs with less than 0.5% mortality rate, based on NIS 1997 low-mortality DRG. If a DRG is divided into “without/with complications,” both DRGs must have mortality rates below 0.5% to qualify for inclusion.

Death in Low-Mortality DRGs

Low-Mortality DRGs
DRGs:

015 Transient ischemic attack and precerebral occlusions
021 Viral meningitis
026 Seizure and headache, age 0-17
030 Traumatic stupor and coma, coma less than one hour, age 0-17
031 Concussion, age greater than 17 with CC
032 Concussion, age greater than 17 without CC
033 Concussion, age 0-17
036 Retinal procedures
037 Orbital procedures
042 Intraocular procedures
044 Acute major eye infections
045 Neurological eye disorders
050 Sialoadenectomy
052 Cleft lip and palate repair
053 Sinus and mastoid procedures, age greater than 17
055 Misc ear, nose, mouth and throat procedures
057 Tonsillectomy and adenoidectomy procedures except tonsillectomy and/or adenoidectomy only, age greater than 17
060 Tonsillectomy and/or adenoidectomy only, age 0-17
062 Myringotomy with tube insertion, age 0-17
063 Other ear, nose, mouth and throat or procedures
065 Dysequilibrium
068 Otitis media and URI, age greater than 17 with CC
070 Otitis media and URI, age 0-17
071 Laryngotracheitis
074 Other ear, nose, mouth and throat diagnoses, age 0-17
091 Simple pneumonia and pleurisy, age 0-17
096 Bronchitis and asthma, age greater than 17 with CC
097 Bronchitis and asthma, age greater than 17 without CC
098 Bronchitis and asthma, age 0-17
125 Circulatory disorders except acute myocardial infarction with cardiac catheterization without complex diagnosis
134 Hypertension
140 Angina pectoris
141 Syncope and collapse with CC
142 Syncope and collapse without CC
143 Chest pain
156 Stomach, esophageal and duodenal procedures, age 0-17
163 Hernia procedures, age 0-17
166 Appendectomy without complicated principal diagnosis with CC
167 Appendectomy without complicated principal diagnosis without CC
184 Esophagitis, gastroenteritis and misc digestive disorders, age 0-17
190 Other digestive system diagnoses, age 0-17
212 Hip and femur procedures except major joint procedures, age 0-17
218 Lower extremity and humerus procedures except hip, foot and femur, age greater than 17 with CC
219 Lower extremity and humerus procedures except hip, foot and femur, age greater than 17 without CC
220 Lower extremity and humerus procedures except hip, foot and femur, age 0-17
223 Major shoulder, elbow procedures or other upper extremity procedures with CC
224 Shoulder, elbow or forearm procedures except major joint procedures without CC
225 Foot procedures
228 Major thumb or joint procedures or other hand or wrist procedures with CC
229 Hand or wrist procedures except major joint procedures without CC
232 Arthroscopy
237 Sprains, strains and dislocations of hip, pelvis and thigh
243 Medical back problems
246 Nonspecific arthropathies
252 Fractures, sprains, strains and dislocations of forearm, hand and foot, age 0-17
255 Fractures, sprains, strains and dislocations of upper arm and lower leg except foot, age 0-17
257 Total mastectomy for malignancy with CC

Death in Low-Mortality DRGs
258 Total mastectomy for malignancy without CC
261 Breast procedure for nonmalignancy except biopsy and local excision
262 Breast biopsy and local excision of nonmalignancy
267 Perianal and pilonical procedures
279 Cellulitis, age 0-17
282 Trauma to skin, subcutaneous tissue and breast, age 0-17
289 Parathyroid procedures
290 Thyroid procedures
293 Other endocrine, nutritional and metabolic or procedures without CC
295 Diabetes, age 0-35
298 Nutritional and misc metabolic disorders, age greater than 17 without CC
317 Admission for renal dialysis
322 Kidney and urinary tract infection, age 0-17
323 Urinary stones with CC and/or esw lithotripsy
324 Urinary stones without CC
333 Other kidney and urinary tract diagnoses, age 0-17
334 Major male pelvic procedures with CC
335 Major male pelvic procedures without CC
336 Transurethral prostatectomy with CC
337 Transurethral prostatectomy without CC
351 Sterilization, male
356 Female reproduction system reconstructive procedures
358 Uterine and adnexa procedures for nonmalignancy with CC
359 Uterine and adnexa procedures for nonmalignancy without CC
360 Vagina, cervix and vulva procedures
361 Laparoscopy and incisional tubal interruption
362 Endoscopic tubal interruption
364 D and C, conization except for malignancy
369 Menstrual and other female reproductive system disorders
370 Cesarean section with CC
371 Cesarean section without CC
372 Vaginal delivery with complicating diagnoses
373 Vaginal delivery without complicating diagnoses
374 Vaginal delivery with sterilization and/or d and c
375 Vaginal delivery with or procedure except sterilization and/or d and c
377 Postpartum and postabortion diagnoses with or procedure
378 Ectopic pregnancy
379 Threatened abortion
380 Abortion without D and C
381 Abortion with D and C, aspiration curettage or hysterotomy
382 False labor
383 Other antepartum diagnoses with medical complications
384 Other antepartum diagnoses without medical complications
393 Splenectomy, age 0-17
396 Red blood cell disorders, age 0-17
421 Viral illness, age greater than 17
422 Viral illness and fever of unknown origin, age 0-17
425 Acute adjustment reactions and disturbances of psychosocial dysfunction
426 Depressive neuroses
427 Neuroses except depressive
428 Disorders of personality and impulse control
431 Childhood mental disorders
432 Other mental disorder diagnoses
434 Alcohol/drug abuse or dependence, detoxification or other symptomatic treatment with CC
435 Alcohol/drug abuse or dependence, detoxification or other symptomatic treatment without CC
436 Alcohol/drug dependence with rehabilitation therapy
439 Skin grafts for injuries
441 Hand procedures for injuries
446 Traumatic injury, age 0-17
448 Allergic reactions, age 0-17
451 Poisoning and toxic effects of drugs, age 0-17
491 Major joint and limb reattachment procedures of upper extremity

Death in Low-Mortality DRGs

499 Back and neck procedures except spinal fusion with CC
500 Back and neck procedures except spinal fusion without CC

Exclude:

Patients with any code for trauma, immunocompromised state, or cancer.

Trauma

ICD-9-CM diagnosis codes (includes 4th and 5th digits):

800 Fracture of vault of skull
801 Fracture of base of skull
802 Fracture of face bones
803 Other and unqualified skull fractures
804 Multiple fractures involving skull or face with other bones
805 Fracture of vertebral column without mention of spinal cord injury
806 Fracture of vertebral column with spinal cord injury
807 Fracture of rib[s] sternum, larynx, and trachea
808 Fracture of pelvis
809 Ill-defined fractures of bones of trunk
810 Fracture of clavicle
811 Fracture of scapula
812 Fracture of humerus
813 Fracture of radius and ulna
814 Fracture of carpal bone[s]
815 Fracture of metacarpal bone[s]
817 Multiple fracture of hand bones
818 Ill-defined fractures of upper limb
819 Multiple fractures involving both upper limbs, and upper limb with rib and sternum
820 Fracture of neck of femur
821 Fracture of other and unspecified parts of femur
822 Fracture of patella
823 Fracture of tibia and fibula
824 Fracture of ankle
825 Fracture of one or more tarsal and metatarsal bones
827 Other, multiple, and ill-defined fractures of lower limb
828 Multiple fractures involving both lower limbs, lower with upper limb, and lower limb with rib and sternum
829 Fracture of unspecified bones
830 Dislocation of jaw
831 Dislocation of shoulder
832 Dislocation of elbow
833 Dislocation of wrist
835 Dislocation of hip
836 Dislocation of knee
837 Dislocation of ankle
838 Dislocation of foot
839 Other, multiple, and ill-defined dislocations
850 Concussion
851 Cerebral laceration and contusion
852 Subarachnoid, subdural, and extradural hemorrhage, following injury
853 Other and unspecified intracranial hemorrhage following injury
854 Intracranial injury of other and unspecified nature
860 Traumatic pneumothorax
861 Injury to heart and lung
862 Injury to other and unspecified intrathoracic organs
863 Injury to gastrointestinal tract
864 Injury to liver
865 Injury to spleen
866 Injury to kidney
867 Injury to pelvic organs
868 Injury to other intra-abdominal organs
869 Internal injury to unspecified or ill-defined organs

Death in Low-Mortality DRGs

870	Open wound of ocular adnexa
871	Open wound of eyeball
872	Open wound of ear
873	Other open wound of head
874	Open wound of neck
875	Open wound of chest [wall]
876	Open wound of back
877	Open wound of buttock
878	Open wound of genital organs [external] including traumatic amputation
879	Open wound of other and unspecified sites, except limbs
880	Open wound of shoulder and upper arm
881	Open wound of elbow, forearm, and wrist
882	Open wound of hand except finger alone
884	Multiple and unspecified open wound of upper limb
887	Traumatic amputation of arm and hand (complete) (partial)
890	Open wound of hip and thigh
891	Open wound of knee, leg (except thigh) and ankle
892	Open wound of foot except toe alone
894	Multiple and unspecified open wound of lower limb
896	Traumatic amputation of foot (complete) (partial)
897	Traumatic amputation of leg[s] (complete) (partial)
900	Injury to blood vessels of head and neck
901	Injury to blood vessels of thorax
902	Injury to blood vessels of abdomen and pelvis
903	Injury to blood vessels of upper extremity
904	Injury to blood vessels of lower extremity and unspecified sites
925	Crushing injury of face, scalp, and neck
926	Crushing injury of trunk
927	Crushing injury of upper limb
928	Crushing injury of lower limb
929	Crushing injury of multiple and unspecified sites
940	Burn confined to eye and adnexa
941	Burn of face, head, and neck
942	Burn of trunk
943	Burn of upper limb, except wrist and hand
944	Burn of wrist[s] and hand[s]
945	Burn of lower limb[s]
946	Burns of multiple specified sites
947	Burn of internal organs
948	Burns classified according to extent of body surface involved
949	Burn, unspecified
952	Spinal chord injury without evidence of spinal bone injury
953	Injury to nerve roots and spinal plexus
958	Certain early complications of trauma

DRGs:

002	Craniotomy for trauma, age greater than 17
027	Traumatic stupor and coma, coma greater than one hour
028	Traumatic stupor and coma, coma less than one hour, age greater than 17 with CC
029	Traumatic stupor and coma, coma less than one hour, age greater than 17 without CC
030	Traumatic stupor and coma, coma less than one hour, age 0-17
031	Concussion, age greater than 17 with CC
032	Concussion, age greater than 17 without CC
033	Concussion, age 0-17
072	Nasal trauma and deformity
083	Major chest trauma with CC
084	Major chest trauma without CC
235	Fractures of femur
236	Fracture of hip and pelvis
237	Sprains, strains and dislocations of hip, pelvis and thigh
440	Wound debridements for injuries

Death in Low-Mortality DRGs

441 Hand procedures for injuries
442 Other OR procedures for injuries with CC
443 Other OR procedures for injuries without CC
444 Traumatic injury, age greater than 17 with CC
445 Traumatic injury, age greater than 17 without CC
446 Traumatic injury, age 0-17
456 No longer valid
457 No longer valid
458 No longer valid
459 No longer valid
460 No longer valid
484 Craniotomy for multiple significant trauma
485 Limb reattachment, hip and femur procedures for multiple significant trauma
486 Other OR procedures for multiple significant trauma
487 Other multiple significant traumas
491 Major joint and limb reattachment procedures of upper extremity
504 Total hepatectomy
505 Extensive 3rd degree burns w/o skin graft
506 Full thickness burn with skin graft or inhalation injury with CC or significant trauma
507 Full thickness burn with skin graft or inhalation injury without CC or significant trauma
508 Full thickness burn without skin graft or inhalation injury with CC or significant trauma
509 Full thickness burn without skin graft or inhalation injury without CC or significant trauma
510 Non-extensive burns with CC or significant trauma
511 Non-extensive burns without CC or significant trauma

Immunocompromised States

ICD-9-CM diagnosis codes:

042 Human immunodeficiency virus disease
1363 Pneumocystosis
27900 Hypogammaglobulinemia NOS
27901 Selective IgA immunodeficiency
27902 Selective IgM immunodeficiency
27903 Other selective immunoglobulin deficiencies
27904 Congenital hypogammaglobulinemia
27905 Immunodeficiency with increased IgM
27906 Common variable immunodefiency
27909 Humoral immunity deficiency NEC
27910 Immunodeficiency with predominant T-cell defect, NOS
27911 DiGeorge's syndrome
27912 Wiskott-Aldrich syndrome
27913 Nezelof's syndrome
27919 Deficiency of cell-mediated immunity, NOS
2792 Combined immunity deficiency
2793 Unspecified immunity deficiency
2794 Autoimmune disease, not elsewhere classified
2798 Other specified disorders involving the immune mechanism
2799 Unspecified disorder of immune mechanism

Complications of transplanted organ:
9968 Complications of transplanted organ
99680 Transplanted organ, unspecified
99681 Kidney transplant
99682 Liver transplant
99683 Heart transplant
99684 Lung transplant
99685 Bone marrow transplant
99686 Pancreas transplant
99687 Intestine transplant
99689 Other specified organ transplant
V420 Kidney replaced by transplant
V421 Heart replaced by transplant

Death in Low-Mortality DRGs

V426 Lung replaced by transplant
V427 Liver replaced by transplant
V428 Other specified organ or tissue
V4281 Bone marrow replaced by transplant
V4282 Peripheral stem cells replaced by transplant
V4283 Pancreas replaced by transplant
V4284 Intestines replace by transplant
V4289 Other replaced by transplant

ICD-9-CM procedure codes:

335 Lung transplantation
3350 Lung transplantation, NOS
3351 Unilateral lung transplantation
3352 Bilateral lung transplantation
336 Combined heart-lung transplantation
375 Heart transplantation
410 Operations on bone marrow and spleen
4100 Bone marrow transplant, NOS
4101 Autologous bone marrow transplant without purging
4102 Allogeneic bone marrow transplant with purging
4103 Allogeneic bone marrow transplant without purging
4104 Autologous hematopoietic stem cell transplant without purging
4105 Allogeneic hematopoietic stem cell transplant without purging
4106 Cord blood stem cell transplant
4107 Autologous hematopoietic stem cell transplant with purging
4108 Allogeneic hematopoietic stem cell transplant with purging
4109 Autologous bone marrow transplant with purging
5051 Auxiliary liver transplant
5059 Liver transplant, NEC
5280 Pancreatic transplant, NOS
5281 Reimplantation of pancreatic tissue
5282 Homotransplant of pancreas
5283 Heterotransplant of pancreas
5285 Allotransplantation of cells of islets of Langerhans
5286 Transplantation of cells of islets of Langerhans, NOS
5569 Other kidney transplantation

Cancer

ICD-9-CM diagnosis codes (includes 4th and 5th digits):

140 Malignant neoplasm of lip
141 Malignant neoplasm of tongue
142 Malignant neoplasm of major salivary glands
143 Malignant neoplasm of gum
144 Malignant neoplasm of floor of mouth
145 Malignant neoplasm of other and unspecified parts of mouth
146 Malignant neoplasm of oropharynx
147 Malignant neoplasm of nasopharynx
148 Malignant neoplasm of hypopharynx
149 Malignant neoplasm of other and ill-defined sites within the lip, oral cavity, and pharynx
150 Malignant neoplasm of esophagus
151 Malignant neoplasm of stomach
152 Malignant neoplasm of small intestine, including duodenum
153 Malignant neoplasm of colon
154 Malignant neoplasm of rectum, rectosigmoid junction, and anus
155 Malignant neoplasm of liver and intrahepatic bile ducts
156 Malignant neoplasm of gallbladder and extrahepatic bile ducts
157 Malignant neoplasm of pancreas
158 Malignant neoplasm of retroperitoneum and peritoneum
159 Malignant neoplasm of other and ill-defined sites within the digestive organs and peritoneum

Death in Low-Mortality DRGs

160	Malignant neoplasm of nasal cavities, middle ear, and accessory sinuses
161	Malignant neoplasm of larynx
162	Malignant neoplasm of trachea, bronchus, and lung
163	Malignant neoplasm of pleura
164	Malignant neoplasm of thymus, heart, and mediastinum
165	Malignant neoplasm of other and ill-defined sites within the respiratory system and intrathoracic organs
170	Malignant neoplasm of bone and articular cartilage
171	Malignant neoplasm of connective and other soft tissue
172	Malignant melanoma of skin
174	Malignant neoplasm of female breast
175	Malignant neoplasm of male breast
176	Karposi's sarcoma
179	Malignant neoplasm of uterus, part unspecified
180	Malignant neoplasm of cervix uteri
181	Malignant neoplasm of eye
182	Malignant neoplasm of body of uterus
183	Malignant neoplasm of ovary and other uterine adnexa
184	Malignant neoplasm of other and unspecified female genital organs
185	Malignant neoplasm of other and unspecified female genital organs
186	Malignant neoplasm of testes
187	Malignant neoplasm of penis and other male genital organs
188	Malignant neoplasm of bladder
189	Malignant neoplasm of kidney and other and unspecified urinary organs
190	Malignant neoplasm of eye
191	Malignant neoplasm of brain
192	Malignant neoplasm of other and unspecified parts of nervous system
193	Malignant neoplasm of thyroid gland
194	Malignant neoplasm of other endocrine glands and related structures
195	Malignant neoplasm of other, and ill-defined sites
196	Secondary and unspecified malignant neoplasm of lymph nodes
197	Secondary malignant neoplasm of respiratory and digestive systems
198	Secondary malignant neoplasm of other specified sites
199	Malignant neoplasm without specification of site
200	Lymphosarcoma and reticulosarcoma
201	Hodgkin's disease
202	Other malignant neoplasms of lymphoid and histiocytic tissues
203	Multiple myeloma and immunoproliferative neoplasms
204	Lymphoid leukemia
205	Myeloid leukemia
206	Monocytic leukemia
207	Other specified leukemia
208	Leukemia of unspecified cell type
2386	Neoplasm of uncertain behavior of other and unspecified sites and tissues, plasma cells
2733	Macroglobulinemia

Personal history of malignant neoplasm:

V1000	Gastrointestinal tract, unspecified
V1001	Tongue
V1002	Other and unspecified oral cavity and pharynx
V1003	Esophagus
V1004	Stomach
V1005	Large intestine
V1006	Rectum, rectosigmoid junction, and anus
V1007	Liver
V1009	Other
V1011	Bronchus and lung
V1012	Trachea
V1020	Respiratory organ, unspecified
V1021	Larynx
V1022	Nasal cavities, middle ear, and accessory sinuses
V1029	Other respiratory and intrathoracic organs, other
V103	Breast

Death in Low-Mortality DRGs

V1040	Female genital organ, unspecified
V1041	Cervix uteri
V1042	Other parts of uterus
V1043	Ovary
V1044	Other female genital organs
V1045	Male genital organ, unspecified
V1046	Prostate
V1047	Testes
V1048	Epididymis
V1049	Other male genital organs
V1050	Urinary organ, unspecified
V1051	Bladder
V1052	Kidney
V1053	Renal pelvis
V1059	Urinary organs, other
V1060	Leukemia, unspecified
V1061	Lymphoid leukemia
V1062	Myeloid leukemia
V1063	Monocytic leukemia
V1069	Leukemia, other
V1071	Lymphosarcoma and reticulosarcoma
V1072	Hodgkin's disease
V1079	Other lymphatic and hematopoietic neoplasms, other
V1081	Bone
V1082	Malignant melanoma of skin
V1083	Other malignant neoplasm of skin
V1084	Eye
V1085	Brain
V1086	Other parts of nervous system
V1087	Thyroid
V1088	Other endocrine glands and related structures
V1089	Other
V109	Unspecified personal history of malignant neoplasm

DRGs:

010	Nervous system neoplasms with CC
011	Nervous system neoplasms without CC
064	Ear, nose, mouth and throat malignancy
082	Respiratory neoplasms
172	Digestive malignancy with CC
173	Digestive malignancy without CC
199	Hepatobiliary diagnostic procedure for malignancy
203	Malignancy of hepatobiliary system or pancreas
239	Pathological fractures and musculoskeletal and connective tissue malignancy
257	Total mastectomy for malignancy with CC
258	Total mastectomy for malignancy without CC
259	Subtotal mastectomy for malignancy with CC
260	Subtotal mastectomy for malignancy without CC
274	Malignant breast disorders with CC
275	Malignant breast disorders without CC
303	Kidney, ureter and major bladder procedures for neoplasm
318	Kidney and urinary tract neoplasms with CC
319	Kidney and urinary tract neoplasms without CC
338	Testes procedures for malignancy
344	Other male reproductive system OR procedures for malignancy
346	Malignancy of male reproductive system with CC
347	Malignancy of male reproductive system without CC
354	Uterine and adnexa procedures for nonovarian/adnexal malignancy with CC
355	Uterine and adnexa procedures for nonovarian/adnexal malignancy without CC
357	Uterine and adnexa procedures for ovarian or adnexal malignancy
363	D and C, conization and radioimplant for malignancy

Death in Low-Mortality DRGs

367	Malignancy of female reproductive system without CC
400	Lymphoma and leukemia with major OR procedures
401	Lymphoma and nonacute leukemia with other OR procedure with CC
402	Lymphoma and nonacute leukemia with other OR procedure without CC
403	Lymphoma and nonacute leukemia with CC
404	Lymphoma and nonacute leukemia without CC
405	Acute leukemia without major or procedure, age 0-17
406	Myeloproliferative disorders or poorly differentiated neoplasms with major OR procedures with CC
407	Myeloproliferative disorders or poorly differentiated neoplasms with major OR procedure without CC
408	Myeloproliferative disorders or poorly differentiated neoplasms with other OR procedures
409	Radiotherapy
410	Chemotherapy without acute leukemia as secondary diagnosis
411	History of malignancy without endoscopy
412	History of malignancy with endoscopy
413	Other myeloproliferative disorders or poorly differentiated neoplasm diagnoses with CC
414	Other myeloproliferative disorders or poorly differentiated neoplasm diagnoses without CC
473	Acute leukemia without major OR procedure, age greater than 17
492	Chemotherapy with acute leukemia as secondary diagnosis

Decubitus Ulcer

Numerator:

Discharges with ICD-9-CM code of 7070 in any secondary diagnosis field per 1,000 discharges.

Denominator:

All medical and surgical discharges defined by specific DRGs (see denominator for **Complications of Anesthesia** for surgical discharges).

Medical Discharges
DRGs:

009	Spinal disorders and injuries
010	Nervous system neoplasms with CC
011	Nervous system neoplasms without CC
012	Degenerative nervous system disorders
013	Multiple sclerosis and cerebellar ataxia
014	Specific cerebrovascular disorders except transient ischemic attack
015	Transient ischemic attack and precerebral occlusions
016	Nonspecific cerebrovascular disorders with CC
017	Nonspecific cerebrovascular disorders without CC
018	Cranial and peripheral nerve disorders with CC
019	Cranial and peripheral nerve disorders without CC
020	Nervous system infection except viral meningitis
021	Viral meningitis
022	Hypertensive encephalopathy
023	Nontraumatic stupor and coma
024	Seizure and headache, age greater than 17 with CC
025	Seizure and headache, age greater than 17 without CC
026	Seizure and headache, age 0-17
027	Traumatic stupor and coma, coma greater than one hour
028	Traumatic stupor and coma, coma less than one hour, age greater than 17 with CC
029	Traumatic stupor and coma, coma less than one hour, age greater than 17 without CC
030	Traumatic stupor and coma, coma less than one hour, age 0-17
031	Concussion, age greater than 17 with CC
032	Concussion, age greater than 17 without CC
033	Concussion, age 0-17

Decubitus Ulcer	
034	Other disorders of nervous system with CC
035	Other disorders of nervous system without CC
043	Hyphema
044	Acute major eye infections
045	Neurological eye disorders
046	Other disorders of the eye, age greater than 17 with CC
047	Other disorders of the eye, age greater than 17 without CC
048	Other disorders of the eye, age 0-17
064	Ear, nose, mouth and throat malignancy
065	Disequilibria
066	Epistaxis
067	Epiglotitis
068	Otitis media and URI, age greater than 17 with CC
069	Otitis media and URI, age greater than 17 without CC
070	Otitis media and URI, age 0-17
071	Laryngotracheitis
072	Nasal trauma and deformity
073	Other ear, nose, mouth and throat diagnoses, age greater than 17
074	Other ear, nose, mouth and throat diagnoses, age 0-17
078	Pulmonary embolism
079	Respiratory infections and inflammations, age greater than 17 with CC
080	Respiratory infections and inflammations, age greater than 17 without CC
081	Respiratory Infections and Inflammations, age 0-17
082	Respiratory neoplasms
083	Major chest trauma with CC
084	Major chest trauma without CC
085	Pleural effusion with CC
086	Pleural effusion without CC
087	Pulmonary edema and respiratory failure
088	Chronic obstructive pulmonary disease
089	Simple pneumonia and pleurisy, age greater than 17 with CC
090	Simple pneumonia and pleurisy, age greater than 17 without CC
091	Simple pneumonia and pleurisy, age 0-17
092	Interstitial lung disease with CC
093	Interstitial lung disease without CC
094	Pneumothorax with CC
095	Pneumothorax without CC
096	Bronchitis and asthma, age greater than 17 with CC
097	Bronchitis and asthma, age greater than 17 without CC
098	Bronchitis and asthma, age 0-17
099	Respiratory signs and symptoms with CC
100	Respiratory signs and symptoms without CC
101	Other respiratory system diagnoses with CC
102	Other respiratory system diagnoses without CC
121	Circulatory disorders with acute myocardial infarction and major complication, discharged alive
122	Circulatory disorders with acute myocardial infarction without major complication, discharged alive
123	Circulatory disorders with acute myocardial infarction, expired
124	Circulatory disorders except acute myocardial infarction with cardiac catheterization and complex diagnosis
125	Circulatory disorders except acute myocardial infarction with cardiac catheterization without complex diagnosis
126	Acute and subacute endocarditis
127	Heart failure and shock
128	Deep vein thrombophlebitis
129	Cardiac arrest, unexplained
130	Peripheral vascular disorders with CC
131	Peripheral vascular disorders without CC
132	Atherosclerosis with CC
133	Atherosclerosis without CC
134	Hypertension
135	Cardiac congenital and valvular disorders, age greater than 17 with CC
136	Cardiac congenital and valvular disorders, age greater than 17 without CC
137	Cardiac congenital and valvular disorders, age 0-17

Decubitus Ulcer	
138	Cardiac arrhythmia and conduction disorders with CC
139	Cardiac arrhythmia and conduction disorders without CC
140	Angina pectoris
141	Syncope and collapse with CC
142	Syncope and collapse without CC
143	Chest pain
144	Other circulatory system diagnoses with CC
145	Other circulatory system diagnoses without CC
172	Digestive malignancy with CC
173	Digestive malignancy without CC
174	GI hemorrhage with CC
175	GI hemorrhage without CC
176	Complicated peptic ulcer
177	Uncomplicated peptic ulcer with CC
178	Uncomplicated peptic ulcer without CC
179	Inflammatory bowel disease
180	GI obstruction with CC
181	GI obstruction without CC
182	Esophagitis, gastroenteritis and miscellaneous digestive disorders, age greater than 17 with CC
183	Esophagitis, gastroenteritis and miscellaneous digestive disorders, age greater than 17 without CC
184	Esophagitis, gastroenteritis and miscellaneous digestive disorders, age 0-17
185	Dental and oral diseases except extractions and restorations, age greater than 17
186	Dental and oral diseases except extractions and restorations, age 0-17
187	Dental extractions and restorations
188	Other digestive system diagnoses, age greater than 17 with CC
189	Other digestive system diagnoses, age greater than 17 without CC
190	Other digestive system diagnoses, age 0-17
202	Cirrhosis and alcoholic hepatitis
203	Malignancy of hepatobiliary system or pancreas
204	Disorders of pancreas except malignancy
205	Disorders of liver except malignancy, cirrhosis and alcoholic hepatitis with CC
206	Disorders of liver except malignancy, cirrhosis and alcoholic hepatitis without CC
207	Disorders of the biliary tract with CC
208	Disorders of the biliary tract without CC
235	Fractures of femur
236	Fractures of hip and pelvis
237	Sprains, strains and dislocations of hip, pelvis and thigh
238	Osteomyelitis
239	Pathological fractures and musculoskeletal and connective tissue malignancy
240	Connective tissue disorders with CC
241	Connective tissue disorders without CC
242	Septic arthritis
243	Medical back problems
244	Bone diseases and specific arthropathies with CC
245	Bone diseases and specific arthropathies without CC
246	Nonspecific arthropathies
247	Signs and symptoms of musculoskeletal system and connective tissue
248	Tendonitis, myositis and bursitis
249	Aftercare, musculoskeletal system and connective tissue
250	Fractures, sprains, strains and dislocations of forearm, hand and foot, age greater than 17 with CC
251	Fractures, sprains, strains and dislocations of forearm, hand and foot, age greater than 17 without CC
252	Fractures, sprains, strains and dislocations of forearm, hand and foot, age 0-17
253	Fractures, sprains, strains and dislocations of upper arm and lower leg except foot, age greater than 17 with CC
254	Fractures, sprains, strains and dislocations of upper arm and lower leg except foot, age greater than 17 without CC
255	Fractures, sprains, strains and dislocations of upper arm and lower leg except foot, age 0-17
256	Other musculoskeletal system and connective tissue diagnoses
271	Skin ulcers
272	Major skin disorders with CC
273	Major skin disorders without CC
274	Malignant breast disorders with CC

Decubitus Ulcer	
275	Malignant breast disorders without CC
276	Nonmalignant breast disorders
277	Cellulitis, age greater than 17 with CC
278	Cellulitis, age greater than 17 without CC
279	Cellulitis, age 0-17
280	Trauma to skin, subcutaneous tissue and breast, age greater than 17 with CC
281	Trauma to skin, subcutaneous tissue and breast, age greater than 17 without CC
282	Trauma to skin, subcutaneous tissue and breast, age 0-17
283	Minor skin disorders with CC
284	Minor skin disorders without CC
294	Diabetes, age greater than 35
295	Diabetes, age 0-35
296	Nutritional and miscellaneous metabolic disorders, age greater than 17 with CC
297	Nutritional and miscellaneous metabolic disorders, age greater than 17 without CC
298	Nutritional and miscellaneous metabolic disorders, age 0-17
299	Inborn errors of metabolism
300	Endocrine disorders with CC
301	Endocrine disorders without CC
316	Renal failure
317	Admission for renal dialysis
318	Kidney and urinary tract neoplasms with CC
319	Kidney and urinary tract neoplasms without CC
320	Kidney and urinary tract infections, age greater than 17 with CC
321	Kidney and urinary tract infections, age greater than 17 without CC
322	Kidney and urinary tract infection, age 0-17
323	Urinary stones with CC and/or ESW lithotripsy
324	Urinary stones without CC
325	Kidney and urinary tract signs and symptoms, age greater than 17 with CC
326	Kidney and urinary tract signs and symptoms, age greater than 17 without CC
327	Kidney and urinary tract signs and symptoms, age 0-17
328	Urethral stricture, age greater than 17 with CC
329	Urethral stricture, age greater than 17 without CC
330	Urethral stricture, age 0-17
331	Other kidney and urinary tract diagnoses, age greater than 17 with CC
332	Other kidney and urinary tract diagnoses, age greater than 17 without CC
333	Other kidney and urinary tract diagnoses, age 0-17
346	Malignancy of male reproductive system with CC
347	Malignancy of male reproductive system without CC
348	Benign prostatic hypertrophy with CC
349	Benign prostatic hypertrophy without CC
350	Inflammation of the male reproductive system
351	Sterilization, male
352	Other male reproductive system diagnoses
366	Malignancy of female reproductive system with CC
367	Malignancy of female reproductive system without CC
368	Infections of female reproductive system
369	Menstrual and other female reproductive system disorders
372	Vaginal delivery with complicating diagnoses
373	Vaginal delivery without complicating diagnoses
376	Postpartum and postabortion diagnoses without OR procedure
378	Ectopic pregnancy
379	Threatened abortion
380	Abortion without D and C
382	False labor
383	Other antepartum diagnoses with medical complications
384	Other antepartum diagnoses without medical complications
395	Red blood cell disorders, age greater than 17
396	Red blood cell disorders, age 0-17
397	Coagulation disorders
398	Reticuloendothelial and immunity disorders with CC
399	Reticuloendothelial and immunity disorders without CC
403	Lymphoma and nonacute leukemia with CC

Decubitus Ulcer	
404	Lymphoma and nonacute leukemia without CC
405	Acute leukemia without major OR procedure, age 0-17
409	Radiotherapy
410	Chemotherapy without acute leukemia as secondary diagnosis
411	History of malignancy without endoscopy
412	History of malignancy with endoscopy
413	Other myeloproliferative disorders or poorly differentiated neoplasm diagnoses with CC
414	Other myeloproliferative disorders or poorly differentiated neoplasm diagnoses without CC
416	Septicemia, age greater than 17
417	Septicemia, age 0-17
418	Postoperative and posttraumatic infections
419	Fever of unknown origin, age greater than 17 with CC
420	Fever of unknown origin, age greater than 17 without CC
421	Viral illness, age greater than 17
422	Viral illness and fever of unknown origin, age 0-17
423	Other infectious and parasitic diseases diagnoses
425	Acute adjustment reactions and disturbances of psychosocial dysfunction
426	Depressive neuroses
427	Neuroses except depressive
428	Disorders of personality and impulse control
429	Organic disturbances and mental retardation
430	Psychoses
431	Childhood mental disorders
432	Other mental disorder diagnoses
433	Alcohol/drug abuse or dependence, left against medical advice
434	Alcohol/drug abuse or dependence, detoxification or other symptomatic treatment with CC
435	Alcohol/drug abuse or dependence, detoxification or other symptomatic treatment without CC
436	Alcohol/drug dependence with rehabilitation therapy
437	Alcohol/drug dependence with combined rehabilitation and detoxification therapy
444	Traumatic injury, age greater than 17 with CC
445	Traumatic injury, age greater than 17 without CC
446	Traumatic injury, age 0-17
447	Allergic reactions, age greater than 17
448	Allergic reactions, age 0-17
449	Poisoning and toxic effects of drugs, age greater than 17 with CC
450	Poisoning and toxic effects of drugs, age greater than 17 without CC
451	Poisoning and toxic effects of drugs, age 0-17
452	Complications of treatment with CC
453	Complications of treatment without CC
454	Other injury, poisoning and toxic effect diagnoses with CC
455	Other injury, poisoning and toxic effect diagnoses without CC
456	No longer valid
457	No longer valid
460	No longer valid
462	Rehabilitation
463	Signs and symptoms with CC
464	Signs and symptoms without CC
465	Aftercare with history of malignancy as secondary diagnosis
466	Aftercare without history of malignancy as secondary diagnosis
467	Other factors influencing health status
473	Acute leukemia without major OR procedure, age greater than 17
474	No longer valid
475	Respiratory system diagnosis with ventilator support
487	Other multiple significant trauma
489	HIV with major related condition
490	HIV with or without other related condition
492	Chemotherapy with acute leukemia as secondary diagnosis
505	Extensive 3rd degree burns without skin graft
508	Full thickness burn without skin graft or inhalation injury with CC or significant trauma
509	Full thickness burn without skin graft or inhalation injury without CC or significant trauma
510	Non-extensive burns with CC or significant trauma
511	Non-extensive burns without CC or significant trauma

Decubitus Ulcer

521 Alcohol/drug abuse or dependence with CC
522 Alcohol/drug abuse or dependence with rehabilitation therapy without CC
523 Alcohol/drug abuse or depend without rehabilitation therapy without CC
524 Transient ischemia

Include only patients with a length of stay of 5 or more days.

Exclude:

Patients in MDC 9(Skin, Subcutaneous Tissue, and Breast) or patients with any diagnosis of hemiplegia, paraplegia, or quadriplegia. Obstetrical patients in MDC 14 (Pregnancy, Childbirth and the Puerperium)
Patients admitted from a long-term care facility.

Hemiplegia, Paraplegia, or Quadriplegia
ICD-9-CM diagnosis codes (includes 4th and 5th digits):

3420 Flaccid hemiplegia
3421 Spastic hemiplegia
3428 Other specified hemiplegia
3429 Hemiplegia, unspecified
3430 Infantile cerebral palsy, diplegic
3431 Infantile cerebral palsy, hemiplegic
3432 Infantile cerebral palsy, quadriplegic
3433 Infantile cerebral palsy, monoplegic
3434 Infantile cerebral palsy infantile hemiplegia
3438 Infantile cerebral palsy other specified infantile cerebral palsy
3439 Infantile cerebral palsy, infantile cerebral palsy, unspecified
3440 Quadriplegia and quadriparesis
3441 Paraplegia
3442 Diplegia of upper limbs
3443 Monoplegia of lower limb
3444 Monoplegia of upper limb
3445 Unspecified monoplegia
3446 Cauda equina syndrome
3448 Other specified paralytic syndromes
3449 Paralysis, unspecified
4382 Hemiplegia/hemiparesis
4383 Monoplegia of upper limb
4384 Monoplegia of lower limb
4385 Other paralytic syndrome

Long-Term Care Facility

Admission source is recorded as long-term care facility (ASource=3)

Failure to Rescue

Numerator:

All discharges with a disposition of “deceased” per 1,000 population at risk.

Denominator:

Discharges with potential complications of care listed in failure to rescue (FTR) definition (e.g., pneumonia, DVT/PE, sepsis, acute renal failure, shock/cardiac arrest, or GI hemorrhage/acute ulcer). **Exclusion criteria specific to each diagnosis**.

Failure to Rescue

FTR—Acute Renal Failure

ICD-9-CM diagnosis codes (includes 4th and 5th digits):

Acute renal failure:
5845 With lesion of tubular necrosis
5846 With lesion of renal cortical necrosis
5847 With lesion of renal medullary necrosis
5848 With other specified pathological lesion
5849 Acute renal failure, unspecified
6393 Complications following abortion and ectopic and molar pregnancies, renal failure
66930 Acute renal failure following labor and delivery, unspecified as to episode of care or not applicable
66932 Acute renal failure following labor and delivery, delivered, with mention of postpartum complication
66934 Acute renal failure following labor and delivery, postpartum condition or complication

Exclude principal diagnosis of acute renal failure, abortion-related renal failure, acute myocardial infarction, cardiac arrest, cardiac arrhythmia, hemorrhage, GI hemorrhage, shock, or trauma.

Acute Renal Failure

ICD-9-CM diagnosis codes (when principal diagnosis):

Acute renal failure:
5845 With lesion of tubular necrosis
5846 With lesion of renal cortical necrosis
5847 With lesion of renal medullary necrosis
5848 With other specified pathological lesion
5849 Acute renal failure, unspecified
6393 Complications following abortion and ectopic and molar pregnancies, renal failure
66930 Acute renal failure following labor and delivery, unspecified as to episode of care or not applicable
66932 Acute renal failure following labor and delivery, delivered, with mention of postpartum complication
66934 Acute renal failure following labor and delivery, postpartum condition or complication

Abortion-related Renal Failure

ICD-9-CM diagnosis codes (when principal diagnosis):

63430 Spontaneous abortion with renal failure - unspecified
63431 Spontaneous abortion with renal failure - incomplete
63432 Spontaneous abortion with renal failure - complete
63530 Legal abortion with renal failure - unspecified
63531 Legal abortion with renal failure - incomplete
63532 Legal abortion with renal failure - complete
63630 Illegal abortion with renal failure - unspecified
63631 Illegal abortion with renal failure - incomplete
63632 Illegal abortion with renal failure - complete
63730 Abortion NOS with renal failure - unspecified
63731 Abortion NOS with renal failure - incomplete
63732 Abortion NOS with renal failure - complete
6383 Attempted abortion with renal failure

Acute Myocardial Infarction

ICD-9-CM diagnosis codes (when principal diagnosis):

41000 AMI of anterolateral wall – episode of care unspecified
41001 AMI of anterolateral wall – initial episode of care
41010 AMI of other anterior wall – episode of care unspecified
41011 AMI of other anterior wall – initial episode of care
41020 AMI of inferolateral wall – episode of care unspecified
41021 AMI of inferolateral wall – initial episode of care
41030 AMI of inferoposterior wall – episode of care unspecified
41031 AMI of inferoposterior wall – initial episode of care

Failure to Rescue

41040 AMI of inferior wall – episode of care unspecified
41041 AMI of inferior wall – initial episode of care
41050 AMI of other lateral wall – episode of care unspecified
41051 AMI of other lateral wall – initial episode of care
41060 AMI true posterior wall infarction – episode of care unspecified
41061 AMI true posterior wall infarction – initial episode of care
41070 AMI subendocardial infarction – episode of care unspecified
41071 AMI subendocardial infarction – initial episode of care
41080 AMI of other specified sites – episode of care unspecified
41081 AMI of other specified sites – initial episode of care
41090 AMI unspecified site – episode of care unspecified
41091 AMI unspecified site – initial episode of care

Cardiac Arrhythmia
ICD-9-CM diagnosis codes (when principal diagnosis):

4260 Atrioventricular block, complete
4270 Paroxysmal supraventricular tachycardia
4271 Paroxysmal ventricular tachycardia
4272 Paroxysmal tachycardia, unspecified
42731 Atrial fibrillation
42732 Atrial flutter
42741 Ventricular fibrillation
42742 Ventricular flutter
4279 Cardiac dysrhythmia

Cardiac Arrest
ICD-9-CM diagnosis code (when principal diagnosis):

4275 Cardiac arrest

Hemorrhage:
ICD-9-CM diagnosis codes (when principal diagnosis):

2851 Acute posthemorrhagic anemia
4590 Other disorders of circulatory system, hemorrhage, unspecified
9582 Certain early complications of trauma, secondary and recurrent hemorrhage
99811 Hemorrhage complicating a procedure

Shock
ICD-9-CM diagnosis codes (when principal diagnosis):

63450 Spontaneous abortion with shock - unspecified
63451 Spontaneous abortion with shock - incomplete
63452 Spontaneous abortion with shock - complete
63550 Legal abortion with shock - unspecified
63551 Legal abortion with shock - incomplete
63552 Legal abortion with shock - complete
63650 Illegal abortion with shock - unspecified
63651 Illegal abortion with shock - incomplete
63652 Illegal abortion with shock - complete
63750 Abortion NOS with shock - unspecified
63751 Abortion NOS with shock - incomplete
63752 Abortion NOS with shock - complete
6385 Attempted abortion with shock
6395 Complications following abortion and ectopic and molar pregnancies, shock
66910 Shock during or following labor and delivery, unspecified as to episode of care or not applicable
66911 Shock during or following labor and delivery, delivered with or without mention of antepartum condition
66912 Shock during or following labor and delivery, delivered with mention of postpartum complication
66913 Shock during or following labor and delivery, antepartum condition or complication
66914 Shock during or following labor and delivery, postpartum condition or complication

Failure to Rescue

7855 Shock without mention of trauma
78550 Shock, unspecified
78551 Cardiogenic shock
78559 Shock without mention of trauma, other
9950 Other anaphylactic shock
9954 Shock due to anesthesia
9980 Postoperative shock
9994 Anaphylactic shock, due to serum

Gastrointestinal (GI) Hemorrhage

ICD-9-CM diagnosis codes (when principal diagnosis):

4560 Esophageal varices with bleeding
45620 Esophageal varices in diseases classified elsewhere with bleeding
5307 Gastroesophageal laceration – hemorrhage syndrome
53082 Esophageal hemorrhage
53100 Gastric ulcer acute with hemorrhage – without mention of obstruction
53101 Gastric ulcer acute with hemorrhage – with obstruction
53120 Gastric ulcer acute with hemorrhage and perforation – without mention of obstruction
53121 Gastric ulcer acute with hemorrhage and perforation – with obstruction
53140 Gastric ulcer chronic or unspecified with hemorrhage – without mention of obstruction
53141 Gastric ulcer chronic or unspecified with hemorrhage – with obstruction
53160 Gastric ulcer chronic or unspecified with hemorrhage and perforation – without mention of obstruction
53161 Gastric ulcer chronic or unspecified with hemorrhage and perforation – with obstruction
53200 Duodenal ulcer acute with hemorrhage – without mention of obstruction
53201 Duodenal ulcer acute with hemorrhage – with obstruction
53220 Duodenal ulcer acute with hemorrhage and perforation – without mention of obstruction
53221 Duodenal ulcer acute with hemorrhage and perforation – with obstruction
53240 Duodenal ulcer chronic or unspecified with hemorrhage – without mention of obstruction
53241 Duodenal ulcer chronic or unspecified with hemorrhage – with obstruction
53260 Duodenal ulcer chronic or unspecified with hemorrhage and perforation – without mention of obstruction
53261 Duodenal ulcer chronic or unspecified with hemorrhage and perforation – with obstruction
53300 Peptic ulcer, site unspecified, acute with hemorrhage – without mention of obstruction
53301 Peptic ulcer, site unspecified, acute with hemorrhage – with obstruction
53320 Peptic ulcer, site unspecified, acute with hemorrhage and perforation – without mention of obstruction
53321 Peptic ulcer, site unspecified, acute with hemorrhage and perforation – with obstruction
53340 Peptic ulcer, site unspecified, chronic or unspecified with hemorrhage – without mention of obstruction
53341 Peptic ulcer, site unspecified, chronic or unspecified with hemorrhage – with obstruction
53360 Peptic ulcer, site unspecified, chronic or unspecified with hemorrhage and perforation – without mention of obstruction
53361 Peptic ulcer, site unspecified, chronic or unspecified with hemorrhage and perforation – with obstruction
53400 Gastrojejunal ulcer, acute with hemorrhage – without mention of obstruction
53401 Gastrojejunal ulcer, acute with hemorrhage – with obstruction
53420 Gastrojejunal ulcer, acute with hemorrhage and perforation – without mention of obstruction
53421 Gastrojejunal ulcer, acute with hemorrhage and perforation – with obstruction
53440 Gastrojejunal ulcer, chronic or unspecified with hemorrhage – without mention of obstruction
53441 Gastrojejunal ulcer, chronic or unspecified with hemorrhage – with obstruction
53460 Gastrojejunal ulcer, chronic or unspecified with hemorrhage and perforation – without mention of obstruction
53461 Gastrojejunal ulcer, chronic or unspecified with hemorrhage and perforation – with obstruction
53501 Gastritis and duodenitis, acute gastritis with hemorrhage
53511 Gastritis and duodenitis, atrophic gastritis with hemorrhage
53521 Gastritis and duodenitis, gastric mucosal hypertrophy, with hemorrhage
53531 Gastritis and duodenitis, alcoholic gastritis, with hemorrhage
53541 Gastritis and duodenitis, other specified gastritis – with hemorrhage
53551 Gastritis and duodenitis, unspecified gastritis and gastroduodenitis – with hemorrhage
53561 Gastritis and duodenitis, duodenitis – with hemorrhage
53783 Other specified disorders of stomach and duodenum, angiodysplasia of stomach and duodenum – with hemorrhage
53784 Dieulafoy lesion (hemorrhagic) of stomach and duodenum
56202 Diverticulosis of small intestine – with hemorrhage
56203 Diverticulitis of small intestine – with hemorrhage
56212 Diverticulosis of colon – with hemorrhage

Failure to Rescue

56213 Diverticulitis of colon – with hemorrhage
5693 Hemorrhage of rectum and anus
56985 Angiodysplasia of intestine - with hemorrhage
56986 Dieulafoy lesion (hemorrhagic) of intestine
5780 Gastrointestinal hemorrhage, hematemesis
5781 Gastrointestinal hemorrhage, blood in stool
5789 Gastrointestinal hemorrhage, hemorrhage of gastrointestinal tract, unspecified

FTR—DVT/PE

Include ICD-9-CM diagnosis codes:

4151 Pulmonary embolism and infarction
41511 Iatrogenic pulmonary embolism
41519 Other pulmonary embolism and infarction
45111 Phlebitis and thorbophlebitis femoral vein (deep) (superficial)
45119 Phlebitis and thorbophlebitis, other deep vessel of lower extremities
4512 Phlebitis and thorbophlebitis, lower extremities
45181 Phlebitis and thorbophlebitis, iliac vein
4519 Phlebitis and thorbophlebitis, unspecified site
4538 Other venous embolism and thrombosis of other specified veins
4539 Other venous embolism and thrombosis of unspecified site

Exclude principal diagnosis of pulmonary embolism or deep vein thrombosis, abortion related and postpartum obstetric pulmonary embolism.

Abortion related and postpartum obstetric pulmonary embolism

ICD-9-CM diagnosis codes (when principal diagnosis):

63460 Spontaneous abortion with embolism - unspecified
63461 Spontaneous abortion with embolism - incomplete
63462 Spontaneous abortion with embolism - complete
63560 Legal abortion with embolism - unspecified
63561 Legal abortion with embolism - incomplete
63562 Legal abortion with embolism - complete
63660 Illegal abortion with embolism - unspecified
63661 Illegal abortion with embolism - incomplete
63662 Illegal abortion with embolism - complete
63760 Abortion NOS with embolism - unspecified
63761 Abortion NOS with embolism - incomplete
63762 Abortion NOS with embolism - complete
6386 Attempted abortion with embolism
6396 Postabortion embolism
67320 Obstetrical blood-clot embolism, unspecified as to episode of care or not applicable
67321 Obstetrical blood-clot embolism, delivered, with or without mention of antepartum condition
67322 Obstetrical blood-clot embolism, delivered, with mention of postpartum complication
67323 Obstetrical blood-clot embolism, antepartum condition or complication
67324 Obstetrical blood-clot embolism, postpartum condition or complication

FTR—Pneumonia

Include ICD-9-CM diagnosis codes:

4820 Pneumonia due to klebsiella pneumoniae
4821 Pneumonia due to pseudomonas
4822 Pneumonia due to hemophilus influenzae [h. influenzae]
48230 Pneumonia due to streptococcus – streptococcus, unspecified
48231 Pneumonia due to streptococcus – group A
48232 Pneumonia due to streptococcus – group B
48239 Pneumonia due to streptococcus – other streptococcus
48240 Pneumonia due to staphylococcus – pneumonia due to staphylococcus, unspecified
48241 Pneumonia due to staphylococcus – pneumonia due to staphyloccoccus aureus

Failure to Rescue

48249 Pneumonia due to staphylococcus – other staphylococcus pneumonia
48281 Pneumonia due to other specified bacteria – anaerobes
48282 Pneumonia due to other specified bacteria – excherichia coli [e coli]
48283 Pneumonia due to other specified bacteria – other gram-negative bacteria
48284 Pneumonia due to other specified bacteria – legionnaires' disease
48289 Pneumonia due to other specified bacteria – other specified bacteria
4829 Bacterial pneumonia unspecified
485 Bronchopneumonia, organism unspecified
486 Pneumonia, organism unspecified
5070 Due to inhalation of food or vomitus
514 Pulmonary congestion and hypostasis

Exclude principal diagnosis code for pneumonia or 997.3, any diagnosis code for viral pneumonia, MDC 4, and any diagnosis of immunocompromised state.

Viral pneumonia
ICD-9-CM diagnosis codes (includes 4th and 5th digits) (when principal diagnosis):

480 Viral pneumonia
481 Pneumococcal pneumonia [streptococcus pneumoniae pneumonia]
483 Pneumonia due to other specified organism
484 Pneumonia in infectious diseases classified elsewhere
485 Bronchopneumonia, organism unspecified
487 Influenza

Immunocompromised States
ICD-9-CM diagnosis codes (when principal diagnosis):

042 Human immunodeficiency virus disease
1363 Pneumocystosis
27900 Hypogammaglobulinemia NOS
27901 Selective IgA immunodeficiency
27902 Selective IgM immunodeficiency
27903 Other selective immunoglobulin deficiencies
27904 Congenital hypogammaglobulinemia
27905 Immunodeficiency with increased IgM
27906 Common variable immunodeficiency
27909 Humoral immunity deficiency NEC
27910 Iimmunodeficiency with predominent T-cell defect, NOS
27911 DiGeorge's syndrome
27912 Wiskott-Aldrich syndrome
27913 Nezelof's syndrome
27919 Deficiency of cell-mediated immunity, NOS
2792 Combined immunity deficiency
2793 Unspecified immunity deficiency
2794 Autoimmune disease, not elsewhere classified
2798 Other specified disorders involving the immune mechanism
2799 Unspecified disorder of immune mechanism

Complications of transplanted organ:
9968 Complications of transplanted organ
99680 Transplanted organ, unspecified
99681 Kidney transplant
99682 Liver transplant
99683 Heart transplant
99684 Lung transplant
99685 Bone marrow transplant
99686 Pancreas transplant
99687 Intestine transplant
99689 Other specified organ transplant

Failure to Rescue

V420 Kidney replaced by transplant
V421 Heart replaced by transplant
V426 Lung replaced by transplant
V427 Liver replaced by transplant
V428 Other specified organ or tissue
V4281 Bone marrow replaced by transplant
V4282 Peripheral stem cells replaced by transplant
V4283 Pancreas replaced by transplant
V4284 Intestines replace by transplant
V4289 Other replaced by transplant

ICD-9-CM procedure codes:

335 Lung transplantation
3350 Lung transplantation, NOS
3351 Unilateral lung transplantation
3352 Bilateral lung transplantation
336 Combined heart-lung transplantation
375 Heart transplantation
410 Operations on bone marow and spleen
4100 Bone marrow transplant, NOS
4101 Autologous bone marrow transplant without purging
4102 Allogenic bone marrow transplant with purging
4103 Allogenic bone marrow transplant without purging
4104 Autologous hematopoietic stem cell transplant without purging
4105 Allogeneic hematopoietic stem cell transplant without purging
4106 Cord blood stem cell transplant
4107 Autologous hematopoietic stem cell transplant with purging
4108 Allogeneic hematopoietic stem cell transplant with purging
4109 Autologous bone marrow transplant with purging
5051 Auxiliary liver transplant
5059 Liver transplant, NEC
5280 Pancreatic transplant, NOS
5281 Reimplantation of pancreatic tissue
5282 Homotranplant of pancreas
5283 Heterotransplant of pancreas
5285 Allotransplantation of cells of islets of Langerhans
5286 Transplantation of cells of islets of Langerhans, NOS
5569 Other kidney transplantation

MDC 4 Diseases and disorders of the respiratory system

FTR—Sepsis

Include ICD-9-CM diagnosis codes:

0380 Streptococcal septicemia
0381 Staphylococcal septicemia
03810 Staphylococcal septicemia, unspecified
03811 Staphylococcus aureau septicemia
03819 Other staphylococcal septicemia
03840 Septicemia due to gram negative organism, unspecified
0382 Pneumococcal septicemia [streptococcus pneumoniae septicemia]
0383 Septicemia due to anaerobes
03841 Septicemia due to other gram-negative organisms, Hemophilus influenze [h. influenzae]
03842 Septicemia due to other gram-negative organisms, Escherichia coli [e coli]
03843 Septicemia due to other gram-negative organisms, Pseudomonas
03844 Septicemia due to other gram-negative organisms, Serratia
03849 Septicemia due to other gram-negative organisms, Other
0388 Other specified septicemias
0389 Unspecified septicemia
7907 Bacteremia

Failure to Rescue

99591 Systemic inflammatory response syndrome due to infectious process without organ dysfunction
99592 Systemic inflammatory response syndrome due to infection process with organ dysfunction

Exclude any diagnosis of immunocompromised state and principal diagnosis of infection or sepsis and patients with a length of stay 3 days or less[124].

Immunocompromised States
ICD-9-CM diagnosis codes (when principal diagnosis):

042 Human immunodeficiency virus disease
1363 Pneumocystosis
27900 Hypogammaglobulinemia NOS
27901 Selective IgA immunodeficiency
27902 Selective IgM immunodeficiency
27903 Other selective immunoglobulin deficiencies
27904 Congenital hypogammaglobulinemia
27905 Immunodeficiency with increased IgM
27906 Common variable immunodeficiency
27909 Humoral immunity deficiency NEC
27910 Immunodeficiency with predominent T-cell defect, NOS
27911 DiGeorge's syndrome
27912 Wiskott-Aldrich syndrome
27913 Nezelof's syndrome
27919 Deficiency of cell-mediated immunity, NOS
2792 Combined immunity deficiency
2793 Unspecified immunity deficiency
2794 Autoimmune disease, not elsewhere classified
2798 Other specified disorders involving the immune mechanism
2799 Unspecified disorder of immune mechanism

Complications of transplanted organ:
9968 Complications of transplanted organ
99680 Transplanted organ, unspecified
99681 Kidney transplant
99682 Liver transplant
99683 Heart transplant
99684 Lung transplant
99685 Bone marrow transplant
99686 Pancreas transplant
99687 Intestine transplant
99689 Other specified organ transplant

V420 Kidney replaced by transplant
V421 Heart replaced by transplant
V426 Lung replaced by transplant
V427 Liver replaced by transplant
V428 Other specified organ or tissue
V4281 Bone marrow replaced by transplant
V4282 Peripheral stem cells replaced by transplant
V4283 Pancreas replaced by transplant
V4284 Intestines replace by transplant
V4289 Other replaced by transplant

ICD-9-CM procedure codes:

335 Lung transplantation
3350 Lung transplantation, NOS
3351 Unilateral lung transplantation

[124] Note: The length of stay exclusion criteria has been corrected in this version of the PSI Guide. The first version noted length of stay of 4 or more days which was incorrect.

Failure to Rescue

3352 Bilateral lung transplantation
336 Combined heart-lung transplantation
375 Heart transplantation
410 Operations on bone marow and spleen
4100 Bone marrow transplant, NOS
4101 Autologous bone marrow transplant without purging
4102 Allogenic bone marrow transplant with purging
4103 Allogenic bone marrow transplant without purging
4104 Autologous hematopoietic stem cell transplant without purging
4105 Allogeneic hematopoietic stem cell transplant without purging
4106 Cord blood stem cell transplant
4107 Autologous hematopoietic stem cell transplant with purging
4108 Allogeneic hematopoietic stem cell transplant with purging
4109 Autologous bone marrow transplant with purging
5051 Auxiliary liver transplant
5059 Liver transplant, NEC
5280 Pancreatic transplant, NOS
5281 Reimplantation of pancreatic tissue
5282 Homotranplant of pancreas
5283 Heterotransplant of pancreas
5285 Allotransplantation of cells of islets of Langerhans
5286 Transplantation of cells of islets of Langerhans, NOS
5569 Other kidney transplantation

Infection

ICD-9-CM diagnosis codes (when principal diagnosis):

5400 Acute appendicitis with generalized peritonitis
5401 Acute appendicitis with peritoneal abscess
5409 Acute appendicitis without mention of peritonitis
541 Appendicitis, unqualified
542 Other appendicitis
56201 Diverticulitis of small intestine (without mention of hemorrhage)
56203 Diverticulitis of small intestine with hemorrhage
56211 Diverticulitis of colon (without mention of hemorrhage)
56213 Diverticulitis of colon with hemorrhage
566 Abscess of anal and rectal regions
5670 Peritonitis in infectious diseases classified elsewhere
5671 Pneumococcal peritonitis
5672 Other suppurative peritonitis
5678 Other specified peritonitis
5679 Unspecified peritonitis
5695 Abscess of intestine
56961 Infection of colostomy or enterostomy
5720 Abscess of liver
5721 Portal pyemia
57400 Calculus of gallbladder with acute cholecystitis - without mention of obstruction
57401 Calculus of gallbladder with acute cholecystits - with obstruction
57430 Calculus of bile duct with acute cholecystitis – without mention of obstruction
57431 Calculus of bile duct with acute cholecystitis - with obstruction
57460 Calculus of gallbladder and bile duct with acute cholecystitis - without mention of obstruction
57461 Calculus of gallbladder and bile duct with acute cholecystitis - with obstruction
57480 Calculus of gallbladder and bile duct with acute and chronic cholecystitis - without mention of obstruction
57481 Calculus of gallbladder and bile duct with acute and chronic cholecystitis - with obstruction
5750 Acute cholecystitis
5754 Perforation of gallbladder
5761 Cholangitis
5763 Perforation of bile duct

DRGs:

Failure to Rescue

020 Nervous system infection except viral meningitis
068 Otitis media and URI, age greater than 17 with CC
069 Otitis media and URI, age greater than 17 without CC
079 Respiratory infections and inflammations, age greater than 17 with CC
080 Respiratory infections and inflammations, age greater than 17 without CC
081 Respiratory infections and inflammations, age 0-17
089 Simple pneumonia and pleurisy, age greater than 17 with CC
090 Simple pneumonia and pleurisy, age greater than 17 without CC
126 Acute and subacute endocarditis
238 Osteomyelitis
242 Septic arthritis
277 Cellulitis, age greater than 17 with CC
278 Cellulitis, age greater than 17 without CC
279 Cellulitis, age 0-17
320 Kidney and urinary tract infections, age greater than 17 with CC
321 Kidney and urinary tract infections, age greater than 17 without CC
322 Kidney and urinary tract infections, age 0-17
368 Infections of female reproductive system
415 OR procedure for infectious and parasitic diseases
416 Septicemia, age greater than 17
417 Septicemia, age 0-17
423 Other infectious and parasitic diseases diagnoses

FTR—Shock or Cardiac Arrest

Include ICD-9-CM diagnosis codes:

4275 cardiac arrest
6395 complications following abortion and ectopic and molar pregnancies, shock

Shock during or following labor and delivery:
66910 Shock during or following labor and delivery – unspecified as to episode of care or not applicable
66911 Shock during or following labor and delivery – delivered, with or without mention of antepartum condition
66912 Shock during or following labor and delivery – delivered, with mention of postpartum complication
66913 Shock during or following labor and delivery – antepartum condition or complication
66914 Shock during or following labor and delivery – postpartum condition or complication
7855 Shock NOS
78550 Shock, unspecified
78551 Cardiogenic shock
78559 Shock without mention of trauma- other
7991 Respiratory arrest
9950 Other anaphylactic shock
9954 Shock due to anesthesia
9980 Postoperative shock
9994 Anaphylactic shock due to serum

ICD-9-CM procedure codes:

9393 Nonmechanical methods of resuscitation
9960 Cardiopulmonary resuscitation, NOS
9963 Closed chest cardiac massage

Exclude MDC 4 and 5, principal diagnosis of shock or cardiac arrest, abortion-related shock, hemorrhage, trauma, GI hemorrhage.

MDC 4 Diseases and disorders of the respiratory system
MDC 5 Diseases and disorders of the circulatory system

Abortion-related Shock

ICD-9-CM diagnosis codes (when principal diagnosis):

Failure to Rescue

63450 Spontaneous abortion with shock - unspecified
63451 Spontaneous abortion with shock - incomplete
63452 Spontaneous abortion with shock - complete
63550 Legal abortion with shock - unspecified
63551 Legal abortion with shock - incomplete
63552 Legal abortion with shock - complete
63650 Illegal abortion with shock - unspecified
63651 Illegal abortion with shock - incomplete
63652 Illegal abortion with shock - complete
63750 Abortion NOS with shock - unspecified
63751 Abortion NOS with shock - incomplete
63752 Abortion NOS with shock - complete
6385 Attempted abortion with shock

FTR—GI Hemorrhage/Acute Ulcer

Include ICD-9-CM diagnosis codes:

4560 Esophageal varices with bleeding
54620 Esophageal varices in diseases classified elsewhere with bleeding

Gastric ulcer:
53130 Acute without mention of hemorrhage or perforation – without mention of obstruction
53131 Acute without mention of hemorrhage or perforation – with obstruction
53190 Unspecified as acute or chronic, without mention of hemorrhage or perforation – without mention of obstruction
53191 Unspecified as acute or chronic, without mention of hemorrhage or perforation – with obstruction

Duodenal ulcer:
53230 Acute without mention of hemorrhage or perforation – without mention of obstruction
53231 Acute without mention of hemorrhage or perforation – with obstruction
53290 Unspecified as acute or chronic, without mention of hemorrhage or perforation – without mention of obstruction
53291 Unspecified as acute or chronic, without mention of hemorrhage or perforation – with obstruction

Peptic ulcer:
53330 Site unspecified acute without mention of hemorrhage and perforation – without mention of obstruction
53331 Site unspecified acute without mention of hemorrhage and perforation – with obstruction
53390 Site unspecified as acute or chronic, without mention of hemorrhage or perforation – without mention of obstruction
53391 Unspecified as acute or chronic, without mention of hemorrhage or perforation – with obstruction

Gastrojejunal ulcer:
53430 Acute without mention of hemorrhage or perforation – without mention of obstruction
53431 Acute without mention of hemorrhage or perforation – with obstruction
53190 Unspecified as acute or chronic, without mention of hemorrhage or perforation – without mention of obstruction
53491 Unspecified as acute or chronic, without mention of hemorrhage or perforation – with obstruction
5307 Gastroesophageal laceration-hemorrhage syndrome
53082 Esophageal hemorrhage

Gastric ulcer:
53100 Acute with hemorrhage – without mention of obstruction
53101 Acute with hemorrhage – with obstruction
53110 Acute with perforation – without mention of obstruction
53111 Acute with perforation – with obstruction
53120 Acute with hemorrhage and perforation – without mention of obstruction
53121 Acute with hemorrhage and perforation – with obstruction
53130 Acute without mention of hemorrhage or perforation – without mention of obstruction

Duodenal ulcer:

Failure to Rescue

53200 Acute with hemorrhage – without mention of obstruction
53201 Acute with hemorrhage – with obstruction
53210 Acute with perforation – without mention of obstruction
53211 Acute with perforation – with obstruction
53220 Acute with hemorrhage and perforation – without mention of obstruction
53221 Acute with hemorrhage and perforation – with obstruction

Peptic ulcer:
53300 Site unspecified acute with hemorrhage – without mention of obstruction
53301 Site unspecified acute with hemorrhage – with obstruction
53310 Site unspecified acute with perforation – without mention of obstruction
53311 Site unspecified acute with perforation – with obstruction
53320 Site unspecified acute with hemorrhage and perforation – without mention of obstruction
53321 Site unspecified acute with hemorrhage and perforation – without mention of obstruction

Gastrojejunal ulcer:
53400 Acute with hemorrhage – without mention of obstruction
53401 Acute with hemorrhage – with obstruction
53410 Acute with perforation – without mention of obstruction
53411 Acute with perforation – with obstruction
53420 Acute with hemorrhage and perforation – without mention of obstruction
53421 Acute with hemorrhage and perforation – with obstruction
53430 Acute without mention of hemorrhage or perforation - without mention of obstruction

Gastritis and duodenitis:
53501 Acute gastritis – with hemorrhage
53511 Atrophic gastritis – with hemorrhage
53521 Gastric mucosal hypertrophy – with hemorrhage
53531 Alcoholic gastritis – with hemorrhage
53541 Other specified gastritis – with hemorrhage
53551 Unspecified gastritis and gastroduodenitis – with hemorrhage
53561 Duodenitis – with hemorrhage
53783 Angiodysplasia of stomach and duodenum – with hemorrhage
53784 Dieulafoy lesion (hemorrhagic) of stomach and duodenum
56202 Diverticulosis of small intestine – with hemorrhage
56203 Diverticulitis of small intestine – with hemorrhage
56212 Diverticulosis of colon – with hemorrhage
56213 Diverticulitis of colon – with hemorrhage
5693 Hemorrhage of rectum and anus
56985 Angiodysplasia of intestine – with hemorrhage
56986 Dieulafoy lesion (hemorrhagic) of intestine
5780 Hematemesis
5781 Blood in stool
5789 Hemorrhage of gastrointestinal tract, unspecified

Exclude MDC codes and ICD-9-CM diagnosis codes*:*

MDC 6 Diseases and disorders of the digestive system
MDC 7 Diseases and disorders of the hepatobiliary system and pancreas

2800 Secondary to blood loss [chronic]
2851 Acute posthemorrhagic anemia

Exclude principal diagnosis of FTR-GI hemorrhage, trauma, and alcoholism.

Alcoholism
ICD-9-CM diagnosis codes (when principal diagnosis):

2910 Alcohol withdrawal delirium
2911 Alcohol amnestic syndrome

Failure to Rescue

2912	Other alcoholic dementia
2913	Alcohol withdrawal hallucinosis
2914	Idiosyncratic alcohol intoxication
2915	Alcoholic jealousy
29181	Other specified alcoholic psychoses, alcohol withdrawal
29189	Other specified alcoholic psychoses, other
2919	Unspecified alcoholic psychosis
30300	Acute alcoholic intoxication - unspecified
30301	Acute alcoholic intoxication - continuous
30302	Acute alcoholic intoxication - episodic
30303	Acute alcoholic intoxication - in remission
30390	Other and unspecified alcohol dependence - unspecified
30391	Other and unspecified alcohol dependence - continuous
30392	Other and unspecified alcohol dependence - episodic
30393	Other and unspecified alcohol dependence - in remission
30500	Nondependent abuse of drugs, alcohol abuse - unspecified
30501	Nondependent abuse of drugs, alcohol abuse - continuous
30502	Nondependent abuse of drugs, alcohol abuse - episodic
30503	Nondependent abuse of drugs, alcohol abuse – in remission
4255	Alcoholic cardiomyopathy
53530	Alcoholic gastritis, without mention of hemorrhage
53531	Alcoholic gastritis, with hemorrhage
5710	Alcoholic fatty liver
5711	Acute alcoholic hepatitis
5712	Alcoholic cirrhosis of liver
5713	Alcoholic liver damage, unspecified
9800	Toxic effect of alcohol, ethyl alcohol
9809	Toxic effect of alcohol, unspecified alcohol

Exclude:

Patients age 75 years and older.

Neonatal patients in MDC 15 (Newborns and Other Neonates with Conditions Originating in the Neonatal Period).

Patients transferred to an acute care facility
Patients transferred from an acute care facility
Patients admitted from a long-term care facility

Transferred to Acute Care Facility

Discharge disposition recorded as transfer to another acute care facility (Discharge Disposition = 2)

Transferred from Acute Care or Long-Term Care Facility

Admission source is recorded as acute care facility (Admission Source = 2)

Admission source is recorded as long-term care facility (Admission Source=3)

Foreign Body Left During Procedure

Numerator:

Discharges with ICD-9-CM codes for foreign body left in during procedure in any secondary diagnosis field per 1,000 surgical discharges.

Foreign Body Left in During Procedure

Foreign Body Left During Procedure

ICD-9-CM diagnosis codes:

9984 Foreign body accidentally left during a procedure
9987 Acute reactions to foreign substance accidentally left during a procedure

Foreign body left in during:
E8710 Surgical operation
E8711 Infusion or transfusion
E8712 Kidney dialysis or other perfusion
E8713 Injection or vaccination
E8714 Endoscopic examination
E8715 Aspiration of fluid or tissue, puncture, and catheterization
E8716 Heart catheterization
E8717 Removal of catheter or packing
E8718 Other specified procedures
E8719 Unspecified procedure

Denominator:

All medical and surgical discharges defined by specific DRGs (see denominators for **Decubitus Ulcer** for medical discharges and **Complications of Anesthesia** for surgical discharges).

Iatrogenic Pneumothorax

Numerator:

Discharges with ICD-9-CM code of 5121 in any secondary diagnosis field per 1,000 discharges.

Denominator:

All medical and surgical discharges defined by specific DRGs (see denominators for **Decubitus Ulcer** for medical discharges and **Complications of Anesthesia** for surgical discharges).

Exclude:

Patients with any diagnosis of trauma.
Patients with any code indicating thoracic surgery, lung or pleural biopsy, or cardiac surgery.
Obstetrical patients in MDC 14 (Pregnancy, Childbirth and the Puerperium).

Trauma
ICD-9-CM diagnosis codes (includes 4th and 5th digits):

800 Fracture of vault of skull
801 Fracture of base of skull
802 Fracture of face bones
803 Other and unqualified skull fractures
804 Multiple fractures involving skull or face with other bones
805 Fracture of vertebral column without mention of spinal cord injury
806 Fracture of vertebral column with spinal cord injury
807 Fracture of rib[s] sternum, larynx, and trachea
808 Fracture of pelvis
809 Ill-defined fractures of bones of trunk
810 Fracture of clavicle
811 Fracture of scapula
812 Fracture of humerous
813 Fracture of radius and ulna
814 Fracture of carpal bone[s]
815 Fracture of metacarpal bone[s]
817 Multiple fracture of hand bones

Iatrogenic Pneumothorax	
818	Ill-defined fractures of upper limb
819	Multiple fractures involving both upper limbs, and upper limb with rib and sternum
820	Fracture of neck of femur
821	Fracture of other and unspecified parts of femur
822	Fracture of patella
823	Fracture of tibia and fibula
824	Fracture of ankle
825	Fracture of one or more tarsal and metatarsal bones
827	Other, multiple, and ill-defined fractures of lower limb
828	Multiple fractures involving both lower limbs, lower with upper limb, and lower limb with rib and sternum
829	Fracture of unspecified bones
830	Dislocation of jaw
831	Dislocation of shoulder
832	Dislocation of elbow
833	Dislocation of wrist
835	Dislocation of hip
836	Dislocation of knee
837	Dislocation of ankle
838	Dislocation of foot
839	Other, multiple, and ill-defined dislocations
850	Concussion
851	Cerebral laceration and contusion
852	Subarachnoid, subdural, and extradural hemorrhage, following injury
853	Other and unspecified intracranial hemorrhage following injury
854	Intracranial injury of other and unspecified nature
860	Traumatic pneumothorax
861	Injury to heart and lung
862	Injury to other and unspecified intrathoracic organs
863	Injury to gastrointestinal tract
864	Injury to liver
865	Injury to spleen
866	Injury to kidney
867	Injury to pelvic organs
868	Injury to other intra-abdominal organs
869	Internal injury to unspecified or ill-defined organs
870	Open wound of ocular adnexa
871	Open wound of eyeball
872	Open wound of ear
873	Other open wound of head
874	Open wound of neck
875	Open wound of chest [wall]
876	Open wound of back
877	Open wound of buttock
878	Open wound of genital organs [external] including traumatic amputation
879	Open wound of other and unspecified sites, except limbs
880	Open wound of shoulder and upper arm
881	Open wound of elbow, forearm, and wrist
882	Open wound of hand except finger alone
884	Multiple and unspecified open wound of upper limb
887	Traumatic amputation of arm and hand (complete) (partial)
890	Open wound of hip and thigh
891	Open wound of knee, leg (except thigh) and ankle
892	Open wound of foot except toe alone
894	Multiple and unspecified open wound of lower limb
896	Traumatic amputation of foot (complete) (partial)
897	Traumatic amputation of leg[s] (complete) (partial)
900	Injury to blood vessels of head and neck
901	Injury to blood vessels of thorax
902	Injury to blood vessels of abdomen and pelvis
903	Injury to blood vessels of upper extremity
904	Injury to blood vessels of lower extremity and unspecified sites
925	Crushing injury of face, scalp, and neck

Iatrogenic Pneumothorax

926 Crushing injury of trunk
927 Crushing injury of upper limb
928 Crushing injury of lower limb
929 Crushing injury of multiple and unspecified sites
940 Burn confined to eye and adnexa
941 Burn of face, head, and neck
942 Burn of trunk
943 Burn of upper limb, except wrist and hand
944 Burn of wrist[s] and hand[s]
945 Burn of lower limb[s]
946 Burns of multiple specified sites
947 Burn of internal organs
948 Burns classified according to extent of body surface involved
949 Burn, unspecified
952 Spinal chord injury without evidence of spinal bone injury
953 Injury to nerve roots and spinal plexus
958 Certain early complications of trauma

DRGs:

002 Craniotomy for trauma, age greater than 17
027 Traumatic stupor and coma, coma greater than one hour
028 Traumatic stupor and coma, coma less than one hour, age greater than 17 with CC
029 Traumatic stupor and coma, coma less than one hour, age greater than 17 without CC
030 Traumatic stupor and coma, coma less than one hour, age 0-17
031 Concussion, age greater than 17 with CC
032 Concussion, age greater than 17 without CC
033 Concussion, age 0-17
072 Nasal trauma and deformity
083 Major chest trauma with CC
084 Major chest trauma without CC
235 Fractures of femur
236 Fracture of hip and pelvis
237 Sprains, strains and dislocations of hip, pelvis and thigh
440 Wound debridements for injuries
441 Hand procedures for injuries
442 Other OR procedures for injuries with CC
443 Other OR procedures for injuries without CC
444 Traumatic injury, age greater than 17 with CC
445 Traumatic injury, age greater than 17 without CC
446 Traumatic injury, age 0-17
456 No longer valid
457 No longer valid
458 No longer valid
459 No longer valid
460 No longer valid
484 Craniotomy for multiple significant trauma
485 Limb reattachment, hip and femur procedures for multiple significant trauma
486 Other OR procedures for multiple significant trauma
487 Other multiple significant traumas
491 Major joint and limb reattachment procedures of upper extremity
504 Total hepatectomy
505 Extensive 3rd degree burns w/o skin graft
506 Full thickness burn with skin graft or inhalation injury with CC or significant trauma
507 Full thickness burn with skin graft or inhalation injury without CC or significant trauma
508 Full thickness burn without skin graft or inhalation injury with CC or significant trauma
509 Full thickness burn without skin graft or inhalation injury without CC or significant trauma
510 Non-extensive burns with CC or significant trauma
511 Non-extensive burns without CC or significant trauma

Iatrogenic Pneumothorax

Thoracic Surgery
ICD-9-CM procedure codes:

3121 Mediastinal tracheostomy
3145 Open biopsy of larynx or trachea
3173 Closure of other fistula of trachea
3179 Other repair and plastic operations on trachea
3199 Other operations on trachea
3209 Other local excision or destruction of lesion or tissue of bronchus
321 Other excision of bronchus

Local excision or destruction of lesion or tissue of lung:
3221 Plication of emphysematious bleb
3222 Lung volume reduction surgery
3228 Endoscopic excision or destruction of lesion or tissue of lung
3229 Other local excision or destruction of lesion or tissue of lung
323 Segmental resection of lung
324 Lobectomy of lung
325 Complete pneumonectomy
326 Radical dissection of thoracic structures
329 Other excision of lung
330 Incision of bronchus
331 Incision of lung
3325 Open biopsy of bronchus
3326 Close [percutaneous][needle] biopsy of lung
3327 Closed endoscopic biopsy of lung
3328 Open biopsy of lung
3331 Destruction of phrenic nerve for collapse of lung (no longer performed)
3332 Artificial pneumothorax for collapse of lung
3334 Thoracoplasty
3339 Other surgical collapse of lung

Repair and plastic operation on lung and bronchus:
3341 Suture of laceration of bronchus
3342 Closure of bronchial fistula
3343 Closure of laceration of lung
3348 Other repair and plastic operations on bronchus
3349 Other repair and plastic operations on lung

Lung transplant:
3350 Lung transplantation, NOS
3351 Unilateral lung transplantation
3352 Bilateral lung transplantation
336 Combined heart-lung transplantation
3392 Ligation of bronchus
3393 Puncture of lung
3398 Other operations on bronchus
3399 Other operations on lung
3329 Other diagnostic procedure on lung and bronchus
3333 Pneumoperitoneum for collapse of lung
3401 Incision of chest wall
3402 Exploratory thoracotomy
3403 Reopening of recent thoracotomy site
3405 Creation of pleuroperitoneal shunt
3409 Other incision of pleura
341 Incision of mediastinum

Diagnostic procedures on chest wall, pleura, mediastinum, and diaphragm:
3421 Transpleural thoracosocopy
3422 Mediastinoscopy

Iatrogenic Pneumothorax

3423 Biopsy of chest wall
3424 Pleural biopsy
3425 Closed [percutaneous][needle] biopsy of mediastinum
3426 Open biopsy of mediastinum
3427 Biopsy of diaphragm
3428 Other diagnostic procedures on chest wall, pleura, and diaphragm
3429 Other diagnostic procedures on mediastinum
343 Excision or destruction of lesion or tissue of mediastinum
344 Excision or destruction of lesion of chest wall
3451 Decortication of lung
3459 Other excision of pleura

Repair of chest wall:
3471 Suture of laceration of chest wall
3472 Closure of thoracostomy
3473 Closure of other fistula of thorax
3474 Repair of pectus deformity
3479 Other repair of chest wall

Operations on diaphragm:
3481 Excision of lesion or tissue of diaphragm
3482 Suture of laceration of diaphragm
3483 Closure of fistula of diaphragm
3484 Other repair of diaphragm
3485 Implantation of diaphragmatic pacemaker
3489 Other operations on diaphragm
3493 Repair of pleura
3499 Other operations on thorax, other

Operations on thoracic duct:
4061 Cannulation of thoracic duct
4062 Fistulization of thoracic duct
4063 Closure of fistula of thoracic duct
4064 Ligation of thoracic duct
4069 Other operations on thoracic duct

Esophagotomy:
4201 Incision of esophageal web
4209 Other incision of esophagus
4210 Esophagostomy, NOS
4211 Cervical esophagostomy
4212 Exteriorization of esophageal pouch
4219 Other external fistulization of esophagus
4221 Operative esophagoscopy by incision
4225 Open biopsy of esophagus
4231 Local excision of esophageal diverticulum
4232 Local excision of other lesion or tissue of esophagus
4239 Other destruction of lesion or tissue of esophagus

Excision of esophagus:
4240 Esophagectomy, NOS
4241 Partial esophagectomy
4242 Total esophagectomy

Intrathoracic anastomosis of exophagus
4251 Intrathoracic esophagoesophagostomy
4252 Intrathoracic esophagogastrostomy
4253 Intrathoracic esophageal anastomosis with interposition of small bowel
4254 Other intrathoracic esophagoenterostomy
4255 Intrathoracic esophageal anastomosis with interposition of colon
4256 Other intrathoracic esophagocolostomy

Iatrogenic Pneumothorax

4258 Intrathoracic esophageal anastomosis with other interposition
4259 Other intrathoracic anastomosis of esophagus

Antesternal anastomosis
4261 Antesternal esophagoesophagostomy
4262 Antesternal esophagogastrostomy
4263 Antesternal esophageal anastomosis with interposition of small bowel
4264 Other antesternal esophagoenterostomy
4265 Antesternal esophageal anastomosis with interposition of colon
4266 Other antesternal esophagocolostomy
4268 Other antesternal esophageal anastomosis with interposition
4269 Other antesternal anastomosis of esophagus
427 Esophagomyotomy

Other repair of esophagus
4281 Insertion of permanent tube into esophagus
4282 Suture of laceration of esophagus
4283 Closure of esophagostomy
4284 Repair of esophageal fistula, NEC
4285 Repair of esophageal stricture
4286 Production of subcutaneous tunnel without esophageal anastomosis
4287 Other graft of esophagus
4289 Other repair of esophagus
4465 Esophagogastroplasty
4466 Other procedures for creation of esophagogastric sphincteric competence
8104 Dorsal and dorso-lumbar fusion, anterior technique
8134 Refusion of dorsal and dorsolumbar spine, anterior technique

Lung or Pleural Biopsy
ICD-9-CM procedure codes:

3326 Closed [percutaneous] [needle] biopsy of lung
3328 Open biopsy of lung
3424 Pleural biopsy

Cardiac Surgery
DRGs:

103 Heart transplant
104 Cardiac valve and other major cardiothoracic procedures with cardiac catheterization
105 Cardiac valve and other major cardiothoracic procedures without cardiac catheterization
106 Coronary bypass with PTCA
107 Coronary bypass with cardiac catheterization
108 Other cardiothoracic procedures
109 Coronary bypass without cardiac catheterization
110 Major cardiovascular procedures with CC
111 Major cardiovascular procedures without CC

Selected Infections Due to Medical Care

Numerator:

Discharges with ICD-9-CM code of 9993 or 99662 in any secondary diagnosis field per 1,000 discharges.

Denominator:

All medical and surgical discharges defined by specific DRGs (see denominators for **Decubitus Ulcer** for medical discharges and **Complications of Anesthesia** for surgical discharges).

Selected Infections Due to Medical Care

Exclude:

Patients with any code for immunocompromised state or cancer.

Immunocompromised States
ICD-9-CM diagnosis codes:

042 Human immunodeficiency virus disease
1363 Pneumocystosis
27900 Hypogammaglobulinemia NOS
27901 Selective IgA immunodeficiency
27902 Selective IgM immunodeficiency
27903 Other selective immunoglobulin deficiencies
27904 Congenital hypogammaglobulinemia
27905 Immunodeficiency with increased IgM
27906 Common variable immunodeficiency
27909 Humoral immunity deficiency NEC
27910 Immunodeficiency with predominent T-cell defect, NOS
27911 DiGeorge's syndrome
27912 Wiskott-Aldrich syndrome
27913 Nezelof's syndrome
27919 Deficiency of cell-mediated immunity, NOS
2792 Combined immunity deficiency
2793 Unspecified immunity deficiency
2794 Autoimmune disease, not elsewhere classified
2798 Other specified disorders involving the immune mechanism
2799 Unspecified disorder of immune mechanism

Complications of transplanted organ:
9968 Complications of transplanted organ
99680 Transplanted organ, unspecified
99681 Kidney transplant
99682 Liver transplant
99683 Heart transplant
99684 Lung transplant
99685 Bone marrow transplant
99686 Pancreas transplant
99687 Intestine transplant
99689 Other specified organ transplant

V420 Kidney replaced by transplant
V421 Heart replaced by transplant
V426 Lung replaced by transplant
V427 Liver replaced by transplant
V428 Other specified organ or tissue
V4281 Bone marrow replaced by transplant
V4282 Peripheral stem cells replaced by transplant
V4283 Pancreas replaced by transplant
V4284 Intestines replace by transplant
V4289 Other replaced by transplant

ICD-9-CM procedure codes:

335 Lung transplantation
3350 Lung transplantation, NOS
3351 Unilateral lung transplantation
3352 Bilateral lung transplantation
336 Combined heart-lung transplantation
375 Heart transplantation
410 Operations on bone marow and spleen
4100 Bone marrow transplant, NOS

Selected Infections Due to Medical Care

4101 Autologous bone marrow transplant without purging
4102 Allogenic bone marrow transplant with purging
4103 Allogenic bone marrow transplant without purging
4104 Autologous hematopoietic stem cell transplant without purging
4105 Allogeneic hematopoietic stem cell transplant without purging
4106 Cord blood stem cell transplant
4107 Autologous hematopoietic stem cell transplant with purging
4108 Allogeneic hematopoietic stem cell transplant with purging
4109 Autologous bone marrow transplant with purging
5051 Auxiliary liver transplant
5059 Liver transplant, NEC
5280 Pancreatic transplant, NOS
5281 Reimplantation of pancreatic tissue
5282 Homotranplant of pancreas
5283 Heterotransplant of pancreas
5285 Allotransplantation of cells of islets of Langerhans
5286 Transplantation of cells of islets of Langerhans, NOS
5569 Other kidney transplantation

Cancer

ICD-9-CM diagnosis codes (include 4th and 5th digits):

140 Malignant neoplasm of lip
141 Malignant neoplasm of tongue
142 Malignant neoplasm of major salivary glands
143 Malignant neoplasm of gum
144 Malignant neoplasm of floor of mouth
145 Malignant neoplasm of other and unspecified parts of mouth
146 Malignant neoplasm of oropharynx
147 Malignant neoplasm of nasopharynx
148 Malignant neoplasm of hypopharynx
149 Malignant neoplasm of other and ill-defined sites within the lip, oral cavity, and pharynx
150 Malignant neoplasm of esophagus
151 Malignant neoplasm of stomach
152 Malignant neoplasm of small intestine, including duodenum
153 Malignant neoplasm of colon
154 Malignant neoplasm of rectum, rectosigmoid junction, and anus
155 Malignant neoplasm of liver and intrahepatic bile ducts
156 Malignant neoplasm of gallbladder and extrahepatic bile ducts
157 Malignant neoplasm of pancreas
158 Malignant neoplasm of retroperitoneum and peritoneum
159 Malignant neoplasm of other and ill-defined sites within the digestive organs and peritoneum
160 Malignant neoplasm of nasal cavities, middle ear, and accessory sinuses
161 Malignant neoplasm of larynx
162 Malignant neoplasm of trachea, bronchus, and lung
163 Malignant neoplasm of pleura
164 Malignant neoplasm of thymus, heart, and mediastinum
165 Malignant neoplasm of other and ill-defined sites within the respiratory system and intrathoracic organs
170 Malignant neoplasm of bone and articular cartilage
171 Malignant neoplasm of connective and other soft tissue
172 Malignant melanoma of skin
174 Malignant neoplasm of female breast
175 Malignant neoplasm of male breast
176 Karposi's sarcoma
179 Malignant neoplasm of uterus, part unspecified
180 Malignant neoplasm of cervix uteri
181 Malignant neoplasm of eye
182 Malignant neoplasm of body of uterus
183 Malignant neoplasm of ovary and other uterine adnexa
184 Malignant neoplasm of other and unspecified female genital organs
185 Malignant neoplasm of other and unspecified female genital organs
186 Malignant neoplasm of testes

Selected Infections Due to Medical Care

187 Malignant neoplasm of penis and other male genital organs
188 Malignant neoplasm of bladder
189 Malignant neoplasm of kidney and other and unspecified urinary organs
190 Malignant neoplasm of eye
191 Malignant neoplasm of brain
192 Malignant neoplasm of other and unspecified parts of nervous system
193 Malignant neoplasm of thyroid gland
194 Malignant neoplasm of other endocrine glands and related structures
195 Malignant neoplasm of other, and ill-defined sites
196 Secondary and unspecified malignant neoplasm of lymph nodes
197 Secondary malignant neoplasm of respiratory and digestive systems
198 Secondary malignant neoplasm of other specified sites
199 Malignant neoplasm without specification of site
200 Lymphosarcoma and reticulosarcoma
201 Hodgkin's disease
202 Other malignant neoplasms of lymphoid and histiocytic tissues
203 Multiple myeloma and immunoproliferative neoplasms
204 Lymphoid leukemia
205 Myeloid leukemia
206 Monocytic leukemia
207 Other specified leukemia
208 Leukemia of unspecified cell type
2386 Neoplasm of uncertain behavior of other and unspecified sites and tissues, plasma cells
2733 Macroglobulinemia

Personal history of malignant neoplasm:
V1000 Gastrointestinal tract, unspecified
V1001 Tongue
V1002 Other and unspecified oral cavity and pharynx
V1003 Esophagus
V1004 Stomach
V1005 Large intestine
V1006 Rectum, rectosigmoid junction, and anus
V1007 Liver
V1009 Other
V1011 Bronchus and lung
V1012 Trachea
V1020 Respiratory organ, unspecified
V1021 Larynx
V1022 Nasal cavities, middle ear, and accessory sinuses
V1029 Other respiratory and intrathoracic organs, other
V103 Breast
V1040 Female genital organ, unspecified
V1041 Cervix uteri
V1042 Other parts of uterus
V1043 Ovary
V1044 Other female genital organs
V1045 Male genital organ, unspecified
V1046 Prostate
V1047 Testes
V1048 Epiddidymis
V1049 Other male genital organs
V1050 Urinary organ, unspecified
V1051 Bladder
V1052 Kidney
V1053 Renal pelvis
V1059 Urinary organs, other
V1060 Leukemia, unspecified
V1061 Lymphid leukemia
V1062 Myeloid leukemia
V1063 Monocytic leukemia
V1069 Leukemia, other

Selected Infections Due to Medical Care

V1071	Lymphosarcoma and reticulosarcoma
V1072	Hodgkins disease
V1079	Other lymphatic and hematopoietic neoplasms, other
V1081	Bone
V1082	Malignant melanoma of skin
V1083	Other malignant neoplasm of skin
V1084	Eye
V1085	Brain
V1086	Other parts of nervous system
V1087	Thyroid
V1088	Other endocrine glands and related structures
V1089	Other
V109	Unspecified personal history of malignant neoplasm

DRGs:

010	Nervous system neoplasms with CC
011	Nervous system neoplasms without CC
064	Ear, nose, mouth and throat malignancy
082	Respiratory neoplasms
172	Digestive malignancy with CC
173	Digestive malignancy without CC
199	Hepatobiliary diagnostic procedure for malignancy
203	Malignancy of hepatobiliary system or pancreas
239	Pathological fractures and musculoskeletal and connective tissue malignancy
257	Total mastectomy for malignancy with CC
258	Total mastectomy for malignancy without CC
259	Subtotal mastectomy for malignancy with CC
260	Subtotal mastectomy for malignancy without CC
274	Malignant breast disorders with CC
275	Malignant breast disorders without CC
303	Kidney, ureter and major bladder procedures for neoplasm
318	Kidney and urinary tract neoplasms with CC
319	Kidney and urinary tract neoplasms without CC
338	Testes procedures for malignancy
344	Other male reproductive system OR procedures for malignancy
346	Malignancy of male reproductive system with CC
347	Malignancy of male reproductive system without CC
354	Uterine and adnexa procedures for nonovarian/adnexal malignancy with CC
355	Uterine and adnexa procedures for nonovarian/adnexal malignancy without CC
357	Uterine and adnexa procedures for ovarian or adnexal malignancy
363	D and C, conization and radioimplant for malignancy
367	Malignancy of female reproductive system without CC
400	Lymphoma and leukemia with major OR procedures
401	Lymphoma and nonacute leukemia with other OR procedure with CC
402	Lymphoma and nonacute leukemia with other OR procedure without CC
403	Lymphoma and nonacute leukemia with CC
404	Lymphoma and nonacute leukemia without CC
405	Acute leukemia without major or procedure, age 0-17
406	Myeloproliferative disorders or poorly differentiated neoplasms with major OR procedures with CC
407	Myeloproliferative disorders or poorly differentiated neoplasms with major OR procedure without CC
408	Myeloproliferative disorders or poorly differentiated neoplasms with other OR procedures
409	Radiotherapy
410	Chemotherapy without acute leukemia as secondary diagnosis
411	History of malignancy without endoscopy
412	History of malignancy with endoscopy
413	Other myeloproliferative disorders or poorly differentiated neoplasm diagnoses with CC
414	Other myeloproliferative disorders or poorly differentiated neoplasm diagnoses without CC
473	Acute leukemia without major OR procedure, age greater than 17
492	Chemotherapy with acute leukemia as secondary diagnosis

Postoperative Hemorrhage or Hematoma

Numerator:

Discharges with ICD-9-CM codes for postoperative hemorrhage in any secondary diagnosis field and postoperative control of hemorrhage in seconday procedure field or postoperative hematoma in any secondary diagnosis field and code for or drainage of hematoma in any secondary procedure code field per 1,000 surgical discharges.

Procedure code for postoperative control of hemorrhage or hematoma must occur on the same day or after the principal procedure.

Postoperative Hematoma
ICD-9-CM diagnosis code:

99812 Hematoma complicating a procedure

Postoperative Hemorrhage
ICD-9-CM diagnosis code:

99811 Hemorrhage complicating a procedure

Control of Postoperative Hemorrhage
ICD-9-CM procedure codes:

287 Control of hemorrhage after tonsillectomy and adenoidectomy
3880 Other surgical occlusion of unspecified site
3881 Other surgical occlusion of intracranial vessels
3882 Other surgical occlusion of other vessels of head and neck
3883 Other surgical occlusion of upper limb vessels
3884 Other surgical occlusion of aorta, abdominal
3885 Other surgical occlusion of thoracic vessel
3886 Other surgical occlusion of abdominal arteries
3887 Other surgical occlusion of abdominal veins
3888 Other surgical occlusion of lower limb arteries
3889 Other surgical occlusion of lower limb veins
3941 Control of hemorrhage following vascular surgery
3998 Control of hemorrhage NOS
4995 Control of (postoperative) hemorrhage of anus
5793 Control of (postoperative hemorrhage of bladder
6094 Control of (postoperative) hemorrhage of prostate

Drainage of Hematoma
ICD-9-CM procedure codes:

1809 Other incision of external ear
540 Incision of abdominal wall
5412 Reopening of recent laparotomy site
5919 Other incision of perivesicle tissue
610 Incision and drainage of scrotum and tunica and vaginalis
6998 Other operations on supporting structures of uterus
7014 Other vaginotomy
7109 Other incision of vulva and perineum
7591 Evacuation of obstetrical incisional hematoma of perineum
7592 Evacuation of other hematoma of vulva or vagina
8604 Other incision with drainage of skin and subcutaneous tissue

Denominator:

Postoperative Hemorrhage or Hematoma

All surgical discharges defined by specific DRGs (see denominator for **Complications of Anesthesia**).

Exclude:

Obstetrical patients in MDC 14 (Pregnancy, Childbirth and the Puerperium).

Postoperative Hip Fracture

Numerator:

Discharges with ICD-9-CM code for hip fracture in any secondary diagnosis field per 1,000 surgical discharges.

Hip Fracture
ICD-9-CM diagnosis codes (includes all 5th digits):

8200	Fracture of neck of femur – transcervical fracture, closed
8201	Fracture of neck of femur – transcervical fracture, open
8202	Fracture of neck of femur – pertrochanteric fracture, closed
8203	Fracture of neck of femur – pertrochanteric fracture, open
8208	Unspecified part of neck of femur, closed
8209	Unspecified part of neck of femur, open

Denominator:

All surgical discharges defined by specific DRGs (see denominator for **Complications of Anesthesia**).

Exclude:

Patients who have diseases and disorders of the musculoskeletal system and connective tissue (MDC 8).

Patients with principal diagnosis codes for seizure, syncope, stroke, coma, cardiac arrest, poisoning, trauma, delirium and other psychoses, or anoxic brain injury.

Patients with any diagnosis of metastatic cancer, lymphoid malignancy or bone malignancy, or self-inflicted injury.

Obstetrical patients in MDC14 (Pregnancy, Childbirth and the Puerperium).

Patients 17 years of age and younger.

Seizure
ICD-9-CM diagnosis codes:

34500	Generalized nonconvulsive epilepsy – without mention of intractable epilepsy
34501	Generalized nonconvulsive epilepsy – with intractable epilepsy
34510	Generalized convulsive epilepsy – without mention of intractable epilepsy
34511	Generalized convulsive epilepsy – with intractable epilepsy
3452	Epilepsy – Petit mal status
3453	Epilepsy – Grand mal status
34540	Partial epilepsy, with impairment of consciousness – with intractable epilepsy
34541	Partial epilepsy, with impairment of consciousness – without mention of intractable epilepsy
34550	Partial epilepsy, without mention of impairment of consciousness – without mention of intractable epilepsy
34551	Partial epilepsy, without mention of impairment of consciousness – with intractable epilepsy
34560	Infantile spasms – without mention of intractable epilepsy
34561	Infantile spasms – with intractable epilepsy
34570	Epilepsia partialis continua – without mention of intractable epilepsy

Postoperative Hip Fracture

34571 Epilepsia partialis continua – with intractable epilepsy
34580 Other forms of epilepsy – without mention of intractable epilepsy
34581 Other forms of epilepsy – with intractable epilepsy
34590 Epilepsy, unspecified – without mention of intractable epilepsy
34591 Epilepsy, unspecified – with intractable epilepsy
78031 Febrile convulsions
78039 Other convulsions
7803 Convulsions (old code no longer valid)

Syncope
ICD-9-CM diagnosis codes:

7802 Syncope and collapse

Stroke
ICD-9-CM diagnosis codes:

430 Subarachnoid hemorrhage
431 Intracerebral hemorrhage
4320 Nontraumatic extradural hemorrhage
4321 Subdural hemorrhage
4329 Unspecified intracranial hemorrhage
436 Acute, but ill-defined cerebrovascular disease
99702 Postoperative cerebrovascular accident

Occlusion and stenosis of precerebral arteries:
43301 Basilar artery, with cerebral infarction
43311 Carotid artery, with cerebral infarction
43321 Vertebral artery - with cerebral infarction
43331 Multiple and bilateral with cerebral infarction
43381 Other specified precerebral artery with cerebral infarction
43391 Occlusion and stenosis of precerebral arteries, unspecified precerebral artery with cerebral infarction

Occlusion of cerebral arteries:
43401 Cerebral thrombosis – with cerebral infarction
43411 Cerebral embolism – with cerebral infarction
43491 Cerebral artery occlusion, unspecified - with cerebral infarction

Coma
ICD-9-CM diagnosis codes:

2510 Other disorders of pancreatic internal secretion, hypoglycemic coma
5722 Liver abscess and sequelae of chronic liver disease, hepatic coma
78001 General symptoms, alteration of consciousness, coma
25020 Diabetes with hyperosmolarity, type 2 [noninsulin dependent type][NIDDM type][adult-onset] or unspecified type, not stated as uncontrolled
25021 Diabetes with hyperosmolarity, type 1 [insulin dependent type][IDDM-type] [juvenile type], not stated as uncontrolled
25022 Diabetes with hyperosmolarity, type 2
25023 Diabetes mellitus, diabetes with hyperosmolarity, type 1 [insulin dependent type][IDDM-type][juvenile type] uncontrolled
25030 Diabetes with other coma, type 2 not stated as uncontrolled
25031 Diabetes with other coma, type 1 not stated as uncontrolled
25032 Diabetes mellitus, diabetes with other coma, type 2 uncontrolled
25033 Diabetes mellitus, diabetes with other coma, type 1 uncontrolled
78003 General symptoms, alteration of consciousness persistent vegetative state

Cardiac Arrest
ICD-9-CM diagnosis code:

Postoperative Hip Fracture

4275 Cardiac arrest

Poisoning

ICD-9-CM diagnosis codes (includes 4th and 5th digits):

960 Poisoning by antibiotics
961 Poisoning by other anti-infectives
962 Poisoning by hormones and synthetic substitutes
963 Poisoning by primarily systemic agents
964 Poisoning by agents primarily affecting blood constituents
965 Poisoning by analgesics, antipyretics, and antirheumatics
966 Poisoning by anticonvulsants and anti-parkinsonism drugs
967 Poisoning by sedatives and hypnotics
968 Poisoning by other central nervous system depressants and anesthetics
969 Poisoning by psychotropic agents
970 Poisoning by central nervous system stimulants
971 Poisoning by drugs primarily affecting the autonomic nervous system
972 Poisoning by agents primarily affecting the cardiovascular system
973 Poisoning by agents primarily affecting the gastrointestinal system
974 Poisoning by water, mineral, and uric acid metabolism drugs
975 Poisoning by agents primarily acting on the smooth and skeletal muscles and respiratory system
976 Poisoning by agents primarily affecting skin and mucous membrane, opthamological, otorhinolaryncological and dental drugs
977 Poisoning by other and unspecified drugs and medicinal substances
978 Poisoning by bacterial vaccines
979 Poisoning by other vaccines and biological substances
E850 Accidental poisoning by analgesics, antipyretics, and antirheumatics
E851 Accidental poisoning by barbiturates
E852 Accidental poisoning by other sedatives and hypnotics
E853 Accidental poisoning by tranquilizers
E854 Accidental poisoning by other psychotropic agents
E855 Accidental poisoning by other drugs acting on central and autonomic nervous system
E856 Accidental poisoning by antibiotics
E857 Accidental poisoning by other anti-infectives
E858 Accidental poisoning by other drugs
E860 Accidental poisoning by alcohol, NEC
E861 accidental poisoning by cleaning and polishing agents, disinfectants, paints, and varnishes
E862 Accidental poisoning by petroleum products, other solvents and their vapors, NEC
E863 Accidental poisoning by agricultural and horticultural chemical and pharmaceutical preparations other than plant foods and fertilizers
E864 Accidental poisoning by corrosives and caustics, NEC
E865 Accidental poisoning from poisonous foodstuffs and poisonous plants
E866 Accidental poisoning by other and unspecified solid and liquid substances
E867 Accidental poisoning by gas distributed by pipeline
E868 Accidental poisoning by other utility gas and other carbon monoxide
E869 Accidental poisoning by other gases and vapors
E951 Suicide and self-inflicted poisoning by gases in domestic use
E952 Suicide and self-inflicted poisoning by other gases and vapors
E962 Assault by poisoning
E980 Poisoning by solid or liquid substances, undetermined whether accidentally or purposely inflicted
E981 Poisoning by gases in domestic use, undetermined whether accidentally or purposely inflicted
E982 Poisoning by other gases, undetermined whether accidentally or purposely inflicted

Trauma

ICD-9-CM diagnosis codes (includes 4th and 5th digits):

800 Fracture of vault of skull
801 Fracture of base of skull
802 Fracture of face bones
803 Other and unqualified skull fractures
804 Multiple fractures involving skull or face with other bones

Postoperative Hip Fracture	
805	Fracture of vertebral column without mention of spinal cord injury
806	Fracture of vertebral column with spinal cord injury
807	Fracture of rib[s] sternum, larynx, and trachea
808	Fracture of pelvis
809	Ill-defined fractures of bones of trunk
810	Fracture of clavicle
811	Fracture of scapula
812	Fracture of humerous
813	Fracture of radius and ulna
814	Fracture of carpal bone[s]
815	Fracture of metacarpal bone[s]
817	Multiple fracture of hand bones
818	Ill-defined fractures of upper limb
819	Multiple fractures involving both upper limbs, and upper limb with rib and sternum
820	Fracture of neck of femur
821	Fracture of other and unspecified parts of femur
822	Fracture of patella
823	Fracture of tibia and fibula
824	Fracture of ankle
825	Fracture of one or more tarsal and metatarsal bones
827	Other, multiple, and ill-defined fractures of lower limb
828	Multiple fractures involving both lower limbs, lower with upper limb, and lower limb with rib and sternum
829	Fracture of unspecified bones
830	Dislocation of jaw
831	Dislocation of shoulder
832	Dislocation of elbow
833	Dislocation of wrist
835	Dislocation of hip
836	Dislocation of knee
837	Dislocation of ankle
838	Dislocation of foot
839	Other, multiple, and ill-defined dislocations
850	Concussion
851	Cerebral laceration and contusion
852	Subarachnoid, subdural, and extradural hemorrhage, following injury
853	Other and unspecified intracranial hemorrhage following injury
854	Intracranial injury of other and unspecified nature
860	Traumatic pneumothorax
861	Injury to heart and lung
862	Injury to other and unspecified intrathoracic organs
863	Injury to gastrointestinal tract
864	Injury to liver
865	Injury to spleen
866	Injury to kidney
867	Injury to pelvic organs
868	Injury to other intra-abdominal organs
869	Internal injury to unspecified or ill-defined organs
870	Open wound of ocular adnexa
871	Open wound of eyeball
872	Open wound of ear
873	Other open wound of head
874	Open wound of neck
875	Open wound of chest [wall]
876	Open wound of back
877	Open wound of buttock
878	Open wound of genital organs [external] including traumatic amputation
879	Open wound of other and unspecified sites, except limbs
880	Open wound of shoulder and upper arm
881	Open wound of elbow, forearm, and wrist
882	Open wound of hand except finger alone
884	Multiple and unspecified open wound of upper limb
887	Traumatic amputation of arm and hand (complete) (partial)

Postoperative Hip Fracture

890	Open wound of hip and thigh
891	Open wound of knee, leg (except thigh) and ankle
892	Open wound of foot except toe alone
894	Multiple and unspecified open wound of lower limb
896	Traumatic amputation of foot (complete) (partial)
897	Traumatic amputation of leg[s] (complete) (partial)
900	Injury to blood vessels of head and neck
901	Injury to blood vessels of thorax
902	Injury to blood vessels of abdomen and pelvis
903	Injury to blood vessels of upper extremity
904	Injury to blood vessels of lower extremity and unspecified sites
925	Crushing injury of face, scalp, and neck
926	Crushing injury of trunk
927	Crushing injury of upper limb
928	Crushing injury of lower limb
929	Crushing injury of multiple and unspecified sites
940	Burn confined to eye and adnexa
941	Burn of face, head, and neck
942	Burn of trunk
943	Burn of upper limb, except wrist and hand
944	Burn of wrist[s] and hand[s]
945	Burn of lower limb[s]
946	Burns of multiple specified sites
947	Burn of internal organs
948	Burns classified according to extent of body surface involved
949	Burn, unspecified
952	Spinal chord injury without evidence of spinal bone injury
953	Injury to nerve roots and spinal plexus
958	Certain early complications of trauma

DRGs:

002	Craniotomy for trauma, age greater than 17
027	Traumatic stupor and coma, coma greater than one hour
028	Traumatic stupor and coma, coma less than one hour, age greater than 17 with CC
029	Traumatic stupor and coma, coma less than one hour, age greater than 17 without CC
030	Traumatic stupor and coma, coma less than one hour, age 0-17
031	Concussion, age greater than 17 with CC
032	Concussion, age greater than 17 without CC
033	Concussion, age 0-17
072	Nasal trauma and deformity
083	Major chest trauma with CC
084	Major chest trauma without CC
235	Fractures of femur
236	Fracture of hip and pelvis
237	Sprains, strains and dislocations of hip, pelvis and thigh
440	Wound debridements for injuries
441	Hand procedures for injuries
442	Other OR procedures for injuries with CC
443	Other OR procedures for injuries without CC
444	Traumatic injury, age greater than 17 with CC
445	Traumatic injury, age greater than 17 without CC
446	Traumatic injury, age 0-17
456	No longer valid
457	No longer valid
458	No longer valid
459	No longer valid
460	No longer valid
484	Craniotomy for multiple significant trauma
485	Limb reattachment, hip and femur procedures for multiple significant trauma
486	Other OR procedures for multiple significant trauma
487	Other multiple significant traumas

Postoperative Hip Fracture

491 Major joint and limb reattachment procedures of upper extremity
504 Total hepatectomy
505 Extensive 3rd degree burns w/o skin graft
506 Full thickness burn with skin graft or inhalation injury with CC or significant trauma
507 Full thickness burn with skin graft or inhalation injury without CC or significant trauma
508 Full thickness burn without skin graft or inhalation injury with CC or significant trauma
509 Full thickness burn without skin graft or inhalation injury without CC or significant trauma
510 Non-extensive burns with CC or significant trauma
511 Non-extensive burns without CC or significant trauma

Delirium and Other Psychoses
ICD-9-CM diagnosis codes (includes 4th and 5th digits):

290 Senile and presenile organic psychotic conditions
291 Alcoholic psychoses
292 Drug psychoses
293 Transient organic psychotic conditions
294 Other organic psychotic conditions
295 Schizophrenic disorders
296 Affective psychoses
297 Paranoid states
298 Other nonorganic psychoses
299 Psychoses with origin specific to childhood

Anoxic Brain Injury
ICD-9-CM diagnosis code:

3481 Anoxic brain damage

Metastatic Cancer
ICD-9-CM diagnosis codes (includes 4th and 5th digits):

196 Secondary and unspecified malignant neoplasm of lymph nodes
197 Secondary malignant neoplasm of respiratory and digestive systems
198 Secondary malignant neoplasm of other specified sites
1990 Malignant neoplasm without specification of site, disseminated

Lymphoid Malignancy
ICD-9-CM diagnosis codes (includes 4th and 5th digits):

200 Lymphosarcoma and reticulosarcoma
201 Hodgkin's disease
202 Other malignant neoplasms of lymphoid and histiocytic tissue
203 Multiple myeloma and immunoproliferative neoplasms
204 Lymphoid leukemia
205 Myeloid leukemia
206 Monocytic leukemia
207 Other specified leukemia
208 Leukemia of unspecified cell type

Bone Malignancy
ICD-9-CM diagnosis code (includes 4th and 5th digits):

170 Malignant neoplasm of bone and articular cartilage

Self-Inflicted Injury
ICD-9-CM diagnosis codes:

Suicide and self-inflicted poisoning by solid or liquid substance:

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E9500 Analgesics, antipyretics, and antirheumatics
E9501 Barbiturates
E9502 Other sedative and hypnotics
E9503 Tranquilizers and other psychotropic agents
E9504 Other specified drugs and medicinal substances
E9505 Unspecified drug or medicinal substance
E9506 Agricultural and horticultural chemical and pharmaceutical preparations other than plant foods and fertilizers
E9507 Corrosive and caustic substances
E9508 Arsenic and its compounds
E9509 Other and unspecified solid and liquid substances

Suicide and self-inflicted poisoning by gases in domestic use:
E9510 Gas distributed by pipeline
E9511 Liquefied petroleum gas distributed in mobile containers
E9518 Other utility gases
E9520 Motor vehicle exhaust gas
E9521 Other carbon monoxide
E9528 Other specified gases and vapors
E9529 Unspecified gases and vapors

Suicide and self-inflicted injury by hanging, strangulation, and suffocation:
E9530 Hanging
E9531 Suffocation by plastic bag
E9538 Other specified means
E954 Suicide and self-inflicted injury by submersion [drowning]

Suicide and self-inflicted injury by firearms and explosives:
E9550 Handgun
E9551 Shotgun
E9552 Hunting rifle
E9553 Military firearms
E9554 Other and unspecified firearms
E9555 Explosives
E9559 Unspecified
E956 Suicide and self inflicted injury by cutting and piercing instrument

Suicide and self-inflicted injury by jumping from a high place:
E9570 Residential premises
E9571 Other man-made structures
E9572 Natural sites
E9573 Unspecified

Suicide and self-inflicted injury by other and unspecified means:
E9580 Jumping or lying before moving object
E9581 Burns, fire
E9582 Scald
E9583 Extremes of cold
E9584 Electrocution
E9585 Crashing of motor vehicle
E9586 Crashing of aircraft
E9587 Caustic substances except poisoning
E9588 Other specified means
E9589 Unspecified means

Postoperative Physiologic and Metabolic Derangement

Numerator:

Postoperative Physiologic and Metabolic Derangement

Discharges with ICD-9-CM codes for physiologic and metabolic derangements in any secondary diagnosis field per 1,000 elective surgical discharges.

Discharges with acute renal failure (subgroup of physiologic and metabolic derangements) must be accompanied by a procedure code for dialysis (3995, 5498).

Physiologic and Metabolic Derangements
ICD-9-CM diagnosis codes:

Diabetes with ketoacidosis:
25010 Type 2, or unspecified type, not stated as uncontrolled
25011 Type 1 not stated as uncontrolled
25012 Type 2, or unspecified type, uncontrolled
25013 Type 1 uncontrolled

Acute renal failure:
5845 With lesion of tubular necrosis
5846 With lesion of renal cortical necrosis
5847 With lesion of renal medullary [papillary] necrosis
5848 With other specified pathological lesion in kidney
5849 Acute renal failure, unspecified

Diabetes with hyperosmolarity:
25020 Type 2, or unspecified type, not stated as uncontrolled
25021 Type 1 not stated as uncontrolled
25022 Type 2, or unspecified type, uncontrolled
25023 Type 1 uncontrolled

Diabetes with other coma:
25030 Type 2, or unspecified type, not stated as uncontrolled
25031 Type 1 not stated as uncontrolled
25032 Type 2, or unspecified type, uncontrolled
25033 Type 1 uncontrolled

Denominator:

All elective surgical discharges defined by admission type and specific DRGs (see denominator for **Complications of Anesthesia** for surgical discharges).

Elective

Admission type # is recorded as elective (ATYPE = 3)

Exclude:

Patients with both a diagnosis code of ketoacidosis, hyperosmolarity, or other coma (subgroups of physiologic and metabolic derangements coding) and a principal diagnosis of diabetes.

Patients with both a secondary diagnosis code for acute renal failure (subgroup of physiologic and metabolic derangements coding) and a principal diagnosis of acute myocardial infarction, cardiac arrhythmia, cardiac arrest, shock, hemorrhage, or gastrointestinal hemorrhage.

Obstetrical patients in MDC 14 (Pregnancy, Childbirth and the Puerperium).

Diabetes
ICD-9-CM diagnosis codes (includes 4th and 5th digits):

2500 Diabetes mellitus without mention of complication
2501 Diabetes with ketoacidosis
2502 Diabetes with hyperosmolarity

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2503 Diabetes with other coma
2504 Diabetes with renal manifestations
2505 Diabetes with ophthalmic manifestations
2506 Diabetes with neurological manifestations
2507 Diabetes with peripheral circulatory disorders
2508 Diabetes with other specified manifestations
2509 Diabetes with other unspecified complications

Acute Myocardial Infarction
ICD-9-CM diagnosis codes:

41000 AMI of anterolateral wall – episode of care unspecified
41001 AMI of anterolateral wall – initial episode of care
41010 AMI of other anterior wall – episode of care unspecified
41011 AMI of other anterior wall – initial episode of care
41020 AMI of inferolateral wall – episode of care unspecified
41021 AMI of inferolateral wall – initial episode of care
41030 AMI of inferoposterior wall – episode of care unspecified
41031 AMI of inferoposterior wall – initial episode of care
41040 AMI of inferior wall – episode of care unspecified
41041 AMI of inferior wall – initial episode of care
41050 AMI of other lateral wall – episode of care unspecified
41051 AMI of other lateral wall – initial episode of care
41060 AMI true posterior wall infarction – episode of care unspecified
41061 AMI true posterior wall infarction – initial episode of care
41070 AMI subendocardial infarction – episode of care unspecified
41071 AMI subendocardial infarction – initial episode of care
41080 AMI of other specified sites – episode of care unspecified
41081 AMI of other specified sites – initial episode of care
41090 AMI unspecified site – episode of care unspecified
41091 AMI unspecified site – initial episode of care

Cardiac Arrhythmia
ICD-9-CM diagnosis codes:

4260 Atrioventricular block, complete
4270 Paroxysmal supraventricular tachycardia
4271 Paroxysmal ventricular tachycardia
4272 Paroxysmal tachycardia, unspecified
42731 Atrial fibrillation
42732 Atrial flutter
42741 Ventricular fibrillation
42742 Ventricular flutter
4279 Cardiac dysrhythmia

DRGs:

138 Cardiac arrhythmia and conduction disorders with CC
139 Cardiac arrhythmia and conduction disorders without CC

Cardiac Arrest
ICD-9-CM diagnosis code:

4275 Cardiac arrest

Shock
ICD-9-CM diagnosis codes:

63450 Spontaneous abortion with shock - unspecified
63451 Spontaneous abortion with shock - incomplete

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63452 Spontaneous abortion with shock - complete
63550 Legal abortion with shock - unspecified
63551 Legal abortion with shock - incomplete
63552 Legal abortion with shock - complete
63650 Illegal abortion with shock - unspecified
63651 Illegal abortion with shock - incomplete
63652 Illegal abortion with shock - complete
63750 Abortion NOS with shock - unspecified
63751 Abortion NOS with shock - incomplete
63752 Abortion NOS with shock - complete
6385 Attempted abortion with shock
6395 Complications following abortion and ectopic and molar pregnancies, shock
66910 Shock during or following labor and delivery, unspecified as to episode of care or not applicable
66911 Shock during or following labor and delivery, delivered with or without mention of antepartum condition
66912 Shock during or following labor and delivery, delivered with mention of postpartum complication
66913 Shock during or following labor and delivery, antepartum condition or complication
66914 Shock during or following labor and delivery, postpartum condition or complication
7855 Shock without mention of trauma
78550 Shock, unspecified
78551 Cardiogenic shock
78559 Shock without mention of trauma, other
9950 Other anaphylactic shock
9954 Shock due to anesthesia
9980 Postoperative shock
9994 Anaphylactic shock, due to serum

Hemorrhage

ICD-9-CM diagnosis codes:

2851 Acute posthemorrhagic anemia
4590 Other disorders of circulatory system, hemorrhage, unspecified
9582 Certain early complications of trauma, secondary and recurrent hemorrhage
99811 Hemorrhage complicating a procedure

Gastrointestinal (GI) Hemorrhage

ICD-9-CM diagnosis codes:

4560 Esophageal varices with bleeding
45620 Esophageal varices in diseases classified elsewhere with bleeding
5307 Gastroesophageal laceration – hemorrhage syndrome
53082 Esophageal hemorrhage
53100 Gastric ulcer acute with hemorrhage – without mention of obstruction
53101 Gastric ulcer acute with hemorrhage – with obstruction
53120 Gastric ulcer acute with hemorrhage and perforation – without mention of obstruction
53121 Gastric ulcer acute with hemorrhage and perforation – with obstruction
53140 Gastric ulcer chronic or unspecified with hemorrhage – without mention of obstruction
53141 Gastric ulcer chronic or unspecified with hemorrhage – with obstruction
53160 Gastric ulcer chronic or unspecified with hemorrhage and perforation – without mention of obstruction
53161 Gastric ulcer chronic or unspecified with hemorrhage and perforation – with obstruction
53200 Duodenal ulcer acute with hemorrhage – without mention of obstruction
53201 Duodenal ulcer acute with hemorrhage – with obstruction
53220 Duodenal ulcer acute with hemorrhage and perforation – without mention of obstruction
53221 Duodenal ulcer acute with hemorrhage and perforation – with obstruction
53240 Duodenal ulcer chronic or unspecified with hemorrhage – without mention of obstruction
53241 Duodenal ulcer chronic or unspecified with hemorrhage – with obstruction
53260 Duodenal ulcer chronic or unspecified with hemorrhage and perforation – without mention of obstruction
53261 Duodenal ulcer chronic or unspecified with hemorrhage and perforation – with obstruction
53300 Peptic ulcer, site unspecified, acute with hemorrhage – without mention of obstruction
53301 Peptic ulcer, site unspecified, acute with hemorrhage – with obstruction
53320 Peptic ulcer, site unspecified, acute with hemorrhage and perforation – without mention of obstruction
53321 Peptic ulcer, site unspecified, acute with hemorrhage and perforation – with obstruction

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53340 Peptic ulcer, site unspecified, chronic or unspecified with hemorrhage – without mention of obstruction
53341 Peptic ulcer, site unspecified, chronic or unspecified with hemorrhage – with obstruction
53360 Peptic ulcer, site unspecified, chronic or unspecified with hemorrhage and perforation – without mention of obstruction
53361 Peptic ulcer, site unspecified, chronic or unspecified with hemorrhage and perforation – with obstruction
53400 Gastrojejunal ulcer, acute with hemorrhage – without mention of obstruction
53401 Gastrojejunal ulcer, acute with hemorrhage – with obstruction
53420 Gastrojejunal ulcer, acute with hemorrhage and perforation – without mention of obstruction
53421 Gastrojejunal ulcer, acute with hemorrhage and perforation – with obstruction
53440 Gastrojejunal ulcer, chronic or unspecified with hemorrhage – without mention of obstruction
53441 Gastrojejunal ulcer, chronic or unspecified with hemorrhage – with obstruction
53460 Gastrojejunal ulcer, chronic or unspecified with hemorrhage and perforation – without mention of obstruction
53461 Gastrojejunal ulcer, chronic or unspecified with hemorrhage and perforation – with obstruction
53501 Gastritis and duodenitis, acute gastritis with hemorrhage
53511 Gastritis and duodenitis, atrophic gastritis with hemorrhage
53521 Gastritis and duodenitis, gastric mucosal hypertrophy, with hemorrhage
53531 Gastritis and duodenitis, alcoholic gastritis, with hemorrhage
53541 Gastritis and duodenitis, other specified gastritis – with hemorrhage
53551 Gastritis and duodenitis, unspecified gastritis and gastroduodenitis – with hemorrhage
53561 Gastritis and duodenitis, duodenitis – with hemorrhage
53783 Other specified disorders of stomach and duodenum, angiodysplasia of stomach and duodenum – with hemorrhage
53784 Dieulafoy lesion (hemorrhagic) of stomach and duodenum
56202 Diverticulosis of small intestine – with hemorrhage
56203 Diverticulitis of small intestine – with hemorrhage
56212 Diverticulosis of colon – with hemorrhage
56213 Diverticulitis of colon – with hemorrhage
5693 Hemorrhage of rectum and anus
56985 Angiodysplasia of intestine - with hemorrhage
56986 Dieulafoy lesion (hemorrhagic) of intestine
5780 Gastrointestinal hemorrhage, hematemesis
5781 Gastrointestinal hemorrhage, blood in stool
5789 Gastrointestinal hemorrhage, hemorrhage of gastrointestinal tract, unspecified

Patients with both a secondary diagnosis code for acute renal failure (subgroup of physiologic and metabolic derangements coding) and a principal diagnosis of acute myocardial infarction, cardiac arrhythmia, cardiac arrest, shock, hemorrhage, or gastrointestinal hemorrhage. See Failure to Rescue for definitions.

Postoperative Pulmonary Embolism or Deep Vein Thrombosis

Numerator:

Discharges with ICD-9-CM codes for deep vein thrombosis or pulmonary embolism in any secondary diagnosis field per 1,000 surgical discharges.

Deep Vein Thrombosis
ICD-9-CM diagnosis codes:

45111 Phlebitis and thrombosis of femoral vein (deep) (superficial)
45119 Phlebitis and thrombophlebitis of deep vessel of lower extremities – other
4512 Phlebitis and thrombophlebitis of lower extremities unspecified
45181 Phlebitis and thrombophlebitis of iliac vein
4519 Phlebitis and thrombophlebitis of other sites - of unspecified site
4538 Other venous embolism and thrombosis of other specified veins
4539 Other venous embolism and thrombosis of unspecified site

Pulmonary Embolism
ICD-9-CM diagnosis codes:

Postoperative Pulmonary Embolism or Deep Vein Thrombosis

41511 Iatrogenic pulmonary embolism and infarction
41519 Pulmonary embolism and infarction, other

Denominator:

All surgical discharges defined by specific DRGs (see denominator for **Complications of Anesthesia**).

Exclude:

Patients with a principal diagnosis of deep vein thrombosis.
Obstetrical patients in MDC 14 (Pregnancy, Childbirth and the Puerperium).
Patients with secondary procedure code 387 when this procedure occurs on the day of or previous to the day of the principal procedure.

Postoperative Respiratory Failure

Numerator:

Discharges with ICD-9-CM codes for acute respiratory failure (51881) in any secondary diagnosis field per 1,000 elective surgical discharges. (After 1999, include 51884).

Denominator:

All elective surgical discharges defined by admission type and specific DRGs (see denominator for **Complications of Anesthesia** for surgical discharges).

Elective

Admission type # is recorded as elective (ATYPE = 3).

Exclude:

Patients with respiratory or circulatory diseases (MDC 4 and 5).
Obstetrical patients in MDC 14 (Pregnancy, Childbirth, and the Puerperium).

Postoperative Sepsis

Numerator:

Discharges with ICD-9-CM code for sepsis in any secondary diagnosis field per 1,000 elective surgical discharges.

Sepsis
ICD-9-CM diagnosis codes:

0380 Streptococcal septicemia
03810 Staphylococcal septicemia, unspecified
03811 Staphylococcus aureus septicemia
03819 Other staphylococcal septicemia
0382 Pneumococcal septicemia (streptococcus pneumoniae septicemia)
0383 Septicemia due to anaerobes

Septicemia due to:
03840 Gram-negative organism, unspecified
03841 Hemophilus influenzae
03842 Escherichia coli

Postoperative Sepsis

03843	Pseudomonas
03844	Serratia
03849	Septicemia due to other gram-negative organisms
0388	Other specified septicemias
0389	Unspecified septicemia
99591	Systemic inflammatory response syndrome due to infectious process without organ dysfunction
99592	Systemic inflammatory response syndrome due to infectious process with organ dysfunction

Denominator:

All elective surgical discharges (see denominator for **Complications of Anesthesia** for surgical discharges).

Elective

Admission type # is recorded as elective (ATYPE = 3)

Exclude:

Patients with a principal diagnosis of infection, or any code for immunocompromised state, or cancer.
Obstetrical patients in MDC 14 (Pregnancy, Childbirth and the Puerperium)

Include only patients with a length of stay of 4 or more days.

Infection
ICD-9-CM diagnosis codes:

5400	Acute appendicitis with generalized peritonitis
5401	Acute appendicitis with peritoneal abscess
5409	Acute appendicitis without mention of peritonitis
541	Appendicitis, unqualified
542	Other appendicitis
56201	Diverticulitis of small intestine (without mention of hemorrhage)
56203	Diverticulitis of small intestine with hemorrhage
56211	Diverticulitis of colon (without mention of hemorrhage)
56213	Diverticulitis of colon with hemorrhage
566	Abscess of anal and rectal regions
5670	Peritonitis in infectious diseases classified elsewhere
5671	Pneumococcal peritonitis
5672	Other suppurative peritonitis
5678	Other specified peritonitis
5679	Unspecified peritonitis
5695	Abscess of intestine
56961	Infection of colostomy or enterostomy
5720	Abscess of liver
5721	Portal pyemia
57400	Calculus of gallbladder with acute cholecystitis - without mention of obstruction
57401	Calculus of gallbladder with acute cholecystits - with obstruction
57430	Calculus of bile duct with acute cholecystitis – without mention of obstruction
57431	Calculus of bile duct with acute cholecystitis - with obstruction
57460	Calculus of gallbladder and bile duct with acute cholecystitis - without mention of obstruction
57461	Calculus of gallbladder and bile duct with acute cholecystitis - with obstruction
57480	Calculus of gallbladder and bile duct with acute and chronic cholecystitis - without mention of obstruction
57481	Calculus of gallbladder and bile duct with acute and chronic cholecystitis - with obstruction
5750	Acute cholecystitis
5754	Perforation of gallbladder
5761	Cholangitis
5763	Perforation of bile duct

Postoperative Sepsis

DRGs:

020 Nervous system infection except viral meningitis
068 Otitis media and URI, age greater than 17 with CC
069 Otitis media and URI, age greater than 17 without CC
079 Respiratory infections and inflammations, age greater than 17 with CC
080 Respiratory infections and inflammations, age greater than 17 without CC
081 Respiratory infections and inflammations, age 0-17
089 Simple pneumonia and pleurisy, age greater than 17 with CC
090 Simple pneumonia and pleurisy, age greater than 17 without CC
126 Acute and subacute endocarditis
238 Osteomyelitis
242 Septic arthritis
277 Cellulitis, age greater than 17 with CC
278 Cellulitis, age greater than 17 without CC
279 Cellulitis, age 0-17
320 Kidney and urinary tract infections, age greater than 17 with CC
321 Kidney and urinary tract infections, age greater than 17 without CC
322 Kidney and urinary tract infections, age 0-17
368 Infections of female reproductive system
415 OR procedure for infectious and parasitic diseases
416 Septicemia, age greater than 17
417 Septicemia, age 0-17
423 Other infectious and parasitic diseases diagnoses

Immunocompromised States

ICD-9-CM diagnosis codes:

042 Human immunodeficiency virus disease
1363 Pneumocystosis
27900 Hypogammaglobulinemia NOS
27901 Selective IgA immunodeficiency
27902 Selective IgM immunodeficiency
27903 Other selective immunoglobulin deficiencies
27904 Congenital hypogammaglobulinemia
27905 Immunodeficiency with increased IgM
27906 Common variable immunodeficiency
27909 Humoral immunity deficiency NEC
27910 Immunodeficiency with predominent T-cell defect, NOS
27911 DiGeorge's syndrome
27912 Wiskott-Aldrich syndrome
27913 Nezelof's syndrome
27919 Deficiency of cell-mediated immunity, NOS
2792 Combined immunity deficiency
2793 Unspecified immunity deficiency
2794 Autoimmune disease, not elsewhere classified
2798 Other specified disorders involving the immune mechanism
2799 Unspecified disorder of immune mechanism

Complications of transplanted organ:
9968 Complications of transplanted organ
99680 Transplanted organ, unspecified
99681 Kidney transplant
99682 Liver transplant
99683 Heart transplant
99684 Lung transplant
99685 Bone marrow transplant
99686 Pancreas transplant
99687 Intestine transplant
99689 Other specified organ transplant

Postoperative Sepsis

V420 Kidney replaced by transplant
V421 Heart replaced by transplant
V426 Lung replaced by transplant
V427 Liver replaced by transplant
V428 Other specified organ or tissue
V4281 Bone marrow replaced by transplant
V4282 Peripheral stem cells replaced by transplant
V4283 Pancreas replaced by transplant
V4284 Intestines replace by transplant
V4289 Other replaced by transplant

ICD-9-CM procedure codes:

335 Lung transplantation
3350 Lung transplantation, NOS
3351 Unilateral lung transplantation
3352 Bilateral lung transplantation
336 Combined heart-lung transplantation
375 Heart transplantation
410 Operations on bone marow and spleen
4100 Bone marrow transplant, NOS
4101 Autologous bone marrow transplant without purging
4102 Allogenic bone marrow transplant with purging
4103 Allogenic bone marrow transplant without purging
4104 Autologous hematopoietic stem cell transplant without purging
4105 Allogeneic hematopoietic stem cell transplant without purging
4106 Cord blood stem cell transplant
4107 Autologous hematopoietic stem cell transplant with purging
4108 Allogeneic hematopoietic stem cell transplant with purging
4109 Autologous bone marrow transplant with purging
5051 Auxiliary liver transplant
5059 Liver transplant, NEC
5280 Pancreatic transplant, NOS
5281 Reimplantation of pancreatic tissue
5282 Homotranplant of pancreas
5283 Heterotransplant of pancreas
5285 Allotransplantation of cells of islets of Langerhans
5286 Transplantation of cells of islets of Langerhans, NOS
5569 Other kidney transplantation

Cancer

ICD-9-CM diagnosis codes (includes 4th and 5th digits):

140 Malignant neoplasm of lip
141 Malignant neoplasm of tongue
142 Malignant neoplasm of major salivary glands
143 Malignant neoplasm of gum
144 Malignant neoplasm of floor of mouth
145 Malignant neoplasm of other and unspecified parts of mouth
146 Malignant neoplasm of oropharynx
147 Malignant neoplasm of nasopharynx
148 Malignant neoplasm of hypopharynx
149 Malignant neoplasm of other and ill-defined sites within the lip, oral cavity, and pharynx
150 Malignant neoplasm of esophagus
151 Malignant neoplasm of stomach
152 Malignant neoplasm of small intestine, including duodenum
153 Malignant neoplasm of colon
154 Malignant neoplasm of rectum, rectosigmoid junction, and anus
155 Malignant neoplasm of liver and intrahepatic bile ducts
156 Malignant neoplasm of gallbladder and extrahepatic bile ducts
157 Malignant neoplasm of pancreas

Postoperative Sepsis

158 Malignant neoplasm of retroperitoneum and peritoneum
159 Malignant neoplasm of other and ill-defined sites within the digestive organs and peritoneum
160 Malignant neoplasm of nasal cavities, middle ear, and accessory sinuses
161 Malignant neoplasm of larynx
162 Malignant neoplasm of trachea, bronchus, and lung
163 Malignant neoplasm of pleura
164 Malignant neoplasm of thymus, heart, and mediastinum
165 Malignant neoplasm of other and ill-defined sites within the respiratory system and intrathoracic organs
170 Malignant neoplasm of bone and articular cartilage
171 Malignant neoplasm of connective and other soft tissue
172 Malignant melanoma of skin
174 Malignant neoplasm of female breast
175 Malignant neoplasm of male breast
176 Karposi's sarcoma
179 Malignant neoplasm of uterus, part unspecified
180 Malignant neoplasm of cervix uteri
181 Malignant neoplasm of eye
182 Malignant neoplasm of body of uterus
183 Malignant neoplasm of ovary and other uterine adnexa
184 Malignant neoplasm of other and unspecified female genital organs
185 Malignant neoplasm of other and unspecified female genital organs
186 Malignant neoplasm of testes
187 Malignant neoplasm of penis and other male genital organs
188 Malignant neoplasm of bladder
189 Malignant neoplasm of kidney and other and unspecified urinary organs
190 Malignant neoplasm of eye
191 Malignant neoplasm of brain
192 Malignant neoplasm of other and unspecified parts of nervous system
193 Malignant neoplasm of thyroid gland
194 Malignant neoplasm of other endocrine glands and related structures
195 Malignant neoplasm of other, and ill-defined sites
196 Secondary and unspecified malignant neoplasm of lymph nodes
197 Secondary malignant neoplasm of respiratory and digestive systems
198 Secondary malignant neoplasm of other specified sites
199 Malignant neoplasm without specification of site
200 Lymphosarcoma and reticulosarcoma
201 Hodgkin's disease
202 Other malignant neoplasms of lymphoid and histiocytic tissues
203 Multiple myeloma and immunoproliferative neoplasms
204 Lymphoid leukemia
205 Myeloid leukemia
206 Monocytic leukemia
207 Other specified leukemia
208 Leukemia of unspecified cell type
2386 Neoplasm of uncertain behavior of other and unspecified sites and tissues, plasma cells
2733 Macroglobulinemia

Personal history of malignant neoplasm:

V1000 Gastrointestinal tract, unspecified
V1001 Tongue
V1002 Other and unspecified oral cavity and pharynx
V1003 Esophagus
V1004 Stomach
V1005 Large intestine
V1006 Rectum, rectosigmoid junction, and anus
V1007 Liver
V1009 Other
V1011 Bronchus and lung
V1012 Trachea
V1020 Respiratory organ, unspecified
V1021 Larynx
V1022 Nasal cavities, middle ear, and accessory sinuses

Postoperative Sepsis

V1029	Other respiratory and intrathoracic organs, other
V103	Breast
V1040	Female genital organ, unspecified
V1041	Cervix uteri
V1042	Other parts of uterus
V1043	Ovary
V1044	Other female genital organs
V1045	Male genital organ, unspecified
V1046	Prostate
V1047	Testes
V1048	Epiddidymis
V1049	Other male genital organs
V1050	Urinary organ, unspecified
V1051	Bladder
V1052	Kidney
V1053	Renal pelvis
V1059	Urinary organs, other
V1060	Leukemia, unspecified
V1061	Lymphoid leukemia
V1062	Myeloid leukemia
V1063	Monocytic leukemia
V1069	Leukemia, other
V1071	Lymphosarcoma and reticulosarcoma
V1072	Hodgkins disease
V1079	Other lymphatic and hematopoietic neoplasms, other
V1081	Bone
V1082	Malignant melanoma of skin
V1083	Other malignant neoplasm of skin
V1084	Eye
V1085	Brain
V1086	Other parts of nervous system
V1087	Thyroid
V1088	Other endocrine glands and related structures
V1089	Other
V109	Unspecified personal history of malignant neoplasm

DRGs:

010	Nervous system neoplasms with CC
011	Nervous system neoplasms without CC
064	Ear, nose, mouth and throat malignancy
082	Respiratory neoplasms
172	Digestive malignancy with CC
173	Digestive malignancy without CC
199	Hepatobiliary diagnostic procedure for malignancy
203	Malignancy of hepatobiliary system or pancreas
239	Pathological fractures and musculoskeletal and connective tissue malignancy
257	Total mastectomy for malignancy with CC
258	Total mastectomy for malignancy without CC
259	Subtotal mastectomy for malignancy with CC
260	Subtotal mastectomy for malignancy without CC
274	Malignant breast disorders with CC
275	Malignant breast disorders without CC
303	Kidney, ureter and major bladder procedures for neoplasm
318	Kidney and urinary tract neoplasms with CC
319	Kidney and urinary tract neoplasms without CC
338	Testes procedures for malignancy
344	Other male reproductive system OR procedures for malignancy
346	Malignancy of male reproductive system with CC
347	Malignancy of male reproductive system without CC
354	Uterine and adnexa procedures for nonovarian/adnexal malignancy with CC
355	Uterine and adnexa procedures for nonovarian/adnexal malignancy without CC

Postoperative Sepsis

357	Uterine and adnexa procedures for ovarian or adnexal malignancy
363	D and C, conization and radioimplant for malignancy
367	Malignancy of female reproductive system without CC
400	Lymphoma and leukemia with major OR procedures
401	Lymphoma and nonacute leukemia with other OR procedure with CC
402	Lymphoma and nonacute leukemia with other OR procedure without CC
403	Lymphoma and nonacute leukemia with CC
404	Lymphoma and nonacute leukemia without CC
405	Acute leukemia without major or procedure, age 0-17
406	Myeloproliferative disorders or poorly differentiated neoplasms with major OR procedures with CC
407	Myeloproliferative disorders or poorly differentiated neoplasms with major OR procedure without CC
408	Myeloproliferative disorders or poorly differentiated neoplasms with other OR procedures
409	Radiotherapy
410	Chemotherapy without acute leukemia as secondary diagnosis
411	History of malignancy without endoscopy
412	History of malignancy with endoscopy
413	Other myeloproliferative disorders or poorly differentiated neoplasm diagnoses with CC
414	Other myeloproliferative disorders or poorly differentiated neoplasm diagnoses without CC
473	Acute leukemia without major OR procedure, age greater than 17
492	Chemotherapy with acute leukemia as secondary diagnosis

Postoperative Wound Dehiscence

Numerator:

Discharges with ICD-9-CM code for reclosure of postoperative disruption of abdominal wall (5461) in any secondary procedure field per 1,000 eligible discharges.

Denominator:

All abdominopelvic surgical discharges.

Exclude:

Obstetrical patients in MDC 14 (Pregnancy, Childbirth and the Puerperium).

Abdominopelvic
ICD-9-CM procedure codes:

3804	Incision of aorta
3806	Incision of abdominal arteries
3807	Incision of abdominal veins
3814	Endarterectomy of aorta
3816	Endarterectomy of abdominal arteries
3834	Resection of aorta with anastomosis
3836	Resection of abdominal arteries with anastomosis
3837	Resection of abdominal veins with anastomosis
3844	Resection of aorta, abdominal with replacement
3846	Resection of abdominal arteries with replacement
3847	Resection of abdominal veins with replacement
3857	Ligation and stripping of varicose veins, abdominal veins
3864	Other excision of aorta, abdominal
3866	Other excision of abdominal arteries
3867	Other excision of abdominal veins
3884	Other surgical occlusion of aorta, abdominal
3886	Other surgical occlusion of abdominal arteries
3887	Other surgical occlusion of abdominal veins
391	Intra-abdominal venous shunt
3924	Aorta-renal bypass
3925	Aorta-iliac-femoral bypass

Postoperative Wound Dehiscence	
3926	Other intra-abdominal vascular shunt or bypass
4052	Radical excision of periaortic lymph nodes
4053	Radical excision of iliac lymph nodes
412	Splenotomy
4133	Open biopsy of spleen
4141	Marsupialization of splenic cyst
4142	Excision of lesion or tissue of spleen
4143	Partial splenectomy
415	Total splenectomy
4193	Excision of accessory spleen
4194	Transplantation of spleen
4195	Repair and plastic operations on spleen
4199	Other operations on spleen
4240	Esophagectomy, NOS
4241	Partial esophagectomy
4242	Total esophagectomy
4253	Intrathoracic esophageal anastomosis with interposition of small bowel
4254	Other intrathoracic esophagoenterostomy
4255	Intrathoracic esophageal anastomosis with interposition of colon
4256	Other intrathoracic esophagocolostomy
4263	Antesternal esophageal anastomosis with interposition of small bowel
4264	Other antesternal esophagoenterostomy
4265	Antesternal esophageal anastomosis with interposition of colon
4266	Other antesternal esophagocolostomy
4291	Ligation of esophageal varices
430	Gastrostomy
4319	Other gastrostomy
433	Pyloromyotomy
4342	Local excision of other lesion or tissue of stomach
4349	Other destruction of lesion or tissue of stomach
435	Partial gastrectomy with anastomosis to esophagus
436	Partial gastrectomy with anastomosis to duodenum
437	Partial gastrectomy with anastomosis to jejunum
4381	Partial gastrectomy with jejuna transposition
4389	Other partial gastrectomy
4391	Total gastrectomy with intestinal interposition
4399	Other total gastrectomy
4400	Vagotomy, NOS
4401	Truncal vagotomy
4402	Highly selective vagotomy
4403	Other selective vagotomy
4411	Transabdominal gastroscopy
4415	Open biopsy of stomach
4421	Dilation of pylorus by incision
4429	Other pyloroplasty
4431	High gastric bypass
4439	Other gastroenterostomy
4440	Suture of peptic ulcer, NOS
4441	Suture of gastric ulcer site
4442	Suture of duodenal ulcer site
445	Revision of gastric anastomosis
4461	Suture of laceration of stomach
4463	Closure of other gastric fistula
4464	Gastropexy
4465	Esophagogastroplasty
4466	Other procedures for creation of esophagogastric sphincteric competence
4469	Other repair of stomach
4491	Ligation of gastric varices
4492	Intraoperative manipulation of stomach
4500	Incision of intestine, NOS
4501	Incision of duodenum
4502	Other incision of small intestine

Postoperative Wound Dehiscence	
4503	Incision of large intestine
4531	Other local excision of lesion of duodenum
4532	Other destruction of lesion of duodenum
4533	Local excision of lesion or tissue of small intestine, except duodenum
4534	Other destruction of lesion of small intestine, except duodenum
4541	Excision of lesion or tissue of large intestine
4549	Other destruction of lesion of large intestine
4550	Isolation of intestinal segment, NOS
4551	Isolation of segment of small intestine
4552	Isolation of segment of large intestine
4561	Multiple segmental resection of small intestine
4562	Other partial resection of small intestine
4563	Total removal of small intestine
4571	Multiple segmental resection of large intestine
4572	Cesectomy
4573	Right hemicolectomy
4574	Resection of transverse colon
4575	Left hemicolectomy
4576	Sigmoidectomy
4579	Other partial excision of large intestine
458	Total intra-abdominal colectomy
4590	Intestinal anastomosis, NOS
4591	Small-to-small intestinal anastomosis
4592	Anastomosis of small intestine to rectal stump
4593	Other small-to-large intestinal anastomosis
4594	Large-to-large intestinal anastomosis
4595	Anastomosis to anus
4601	Exteriorization of small intestine
4603	Exteriorization of large intestine
4610	Colostomy, NOS
4611	Temporary colostomy
4613	Permanent colostomy
4620	Ileostomy, NOS
4621	Temporary ilesostomy
4622	Continent ileostomy
4623	Other permanent ileostomy
4640	Revision of intestina stoma, NOS
4641	Revision of stoma of small intestine
4642	Repair of pericolostomy hernia
4643	Other revision of stoma of large intestine
4650	Closure of intestinal stoma, NOS
4651	Closure of stoma of small intestine
4652	Closure of stoma of large intestine
4660	Fixation of intestine, NOS
4661	Fixation of small intestine to abdominal wall
4662	Other fixation of small intestine
4663	Fixation of large intestine to abdominal wall
4664	Other fixation of large intestine
4672	Closure of fistula of duodenum
4674	Closure of fistula of small intestine, except duodenum
4676	Closure of fistula of large intestine
4680	Intra-abdominal manipulation of intestine, NOS
4681	Intra-abdominal manipulation of small intestine
4682	Intra-abdominal manipulation of large intestine
4691	Myotomy of sigmoid colon
4692	Myotomy of other parts of colon
4693	Revision of anastomosis of small intestine
4694	Revision of anastomosis of large intestine
4699	Other operations on intestines
4709	Other appendectomy
4719	Other incidental appendectomy
472	Drainage of appendiceal abscess

Postoperative Wound Dehiscence	
4791	Appendectomy
4792	Closure of appendiceal fistula
4799	Other operations on appendix, other
4841	Submucosal resection of rectum
4849	Other pull-through resection of rectum
485	Abdominoperineal resection of rectum
4875	Abdominal proctopexy
500	Hepatotomy
5012	Open biopsy of liver
5021	Marsupialization of lesion of liver
5022	Partial hepatectomy
5029	Other destruction of lesion of liver
503	Lobectomy of liver
504	Total hepatectomy
5051	Auxiliary liver transplant
5059	Other transplant of liver
5069	Other repair of liver
5103	Other cholecystostomy
5104	Other cholecystotomy
5113	Open biopsy of gallbladder or bile ducts
5121	Other partial cholecystectomy
5122	Cholecystectomy
5131	Anastomosis of gallbladder to hepatic ducts
5132	Anastomosis of gallbladder to intestine
5133	Anastomosis of gallbladder to pancreas
5134	Anastomosis of gallbladder to stomach
5135	Other gallbladder anastomosis
5136	Choledochoenterostomy
5137	Anastomosis of hepatic duct to gastrointestinal tract
5139	Other bile duct anastomosis
5141	Common duct exploration for removal of calculus
5142	Common duct exploration for relief of other obstruction
5143	Insertion of choledochohepatic tube for decompression
5149	Incision of other bile ducts for relief of obstruction
5151	Exploration of common duct
5159	Incision of other bile duct
5161	Excision of cystic duct remnant
5162	Excision of ampulla of vater with reimplantation of common duct
5163	Other excision of common duct
5169	Excision of other bile duct
5171	Simple suture of common bile duct
5172	Choledochoplasty
5179	Repair of other bile ducts
5181	Dilation of sphincter of Oddi
5182	Pancreatic sphincterotomy
5183	Pancreatic sphincteroplasty
5189	Other operations on sphincter of Oddi
5192	Closure of cholecystostomy
5193	Closure of other biliary fistula
5194	Revision of anastomosis of biliary tract
5195	Removal of prosthetic device from bile duct
5199	Other operations on biliary tract
5201	Drainage of pancreatic cyst by catheter
5209	Other pancreatotomy
5212	Open biopsy of pancreas
5222	Other excision or destruction of lesion or tissue of pancreas or pancreatic duct
523	Marsupialization of pancreatic cyst
524	Internal drainage of pancreatic cyst
5251	Proximal pancreatectomy
5252	Distal pancreatectomy
5253	Radical subtotal pancreatectomy
5259	Other partial pancreatectomy

Postoperative Wound Dehiscence	
526	Total pancreatectomy
527	Radical pancreaticoduodenectomy
5280	Pancreatic transplant, NOS
5281	Reimplantation
5282	Homotransplant of pancreas
5283	Heterotransplant of pancreas
5292	Cannulation of pancreatic duct
5295	Other repair of pancreas
5296	Anastomosis of pancreas
5299	Other operations on pancreas
5300	Unilateral repair of inguinal hernia, NOS
5301	Repair of direct inguinal hernia
5302	Repair of indirect inguinal hernia
5303	Repair of direct inguinal hernia with graft or prosthesis
5304	Repair of indirect inguinal hernia with graft or prosthesis
5305	Repair of inguinal hernia with graft or prosthesis, NOS
5310	Bilateral repair of inguinal hernia, NOS
5311	Bilateral repair of direct inguinal hernia
5312	Bilateral repair of indirect inguinal hernia
5313	Bilateral repair of inguinal hernia, one direct and one indirect
5314	Bilateral repair of direct inguinal hernia with graft or prosthesis
5315	Bilateral repair of indirect inguinal hernia with graft or prosthesis
5316	Bilateral repair of inguinal hernia, one direct and one indirect, with graft or prosthesis
5317	Bilateral inguinal hernia repair with graft or prosthesis, NOS
5321	Unilateral repair of femoral hernia
5329	Other unilateral femoral herniorrhaphy
5331	Bilateral repair of femoral hernia with graft or prosthesis
5339	Other bilateral femoral herniorrhaphy
5341	Repair of umbilical hernia with prosthesis
5349	Other umbilical herniorrhaphy
5351	Incisional hernia repair
5359	Repair of other hernia of anterior abdominal wall
5361	Incisional hernia repair with prosthesis
5369	Repair of other hernia of anterior abdominal wall with prosthesis
537	Repair of diaphragmatic hernia, abdominal approach
540	Incision of abdominal wall
5411	Exploratory laparotomy
5419	Other laparotomy
5422	Biopsy of abdominal wall or umbilicus
5423	Biopsy of abdominal wall or umbilicus
543	Excision or destruction of lesion or tissue of abdominal wall or umbilicus
544	Excision or destruction of peritoneal tissue
5459	Other lysis of peritoneal adhesions
5463	Other suture of abdominal wall
5464	Suture of peritoneum
5471	Repair of gastroschisis
5472	Other repair of abdominal walls
5473	Other repair of peritoneum
5474	Other repair of omentum
5475	Other repair of mesentery
5492	Removal of foreign body from peritoneal cavity
5493	Creation of cutaneoperitoneal fistula
5494	Creation of peritoneovascular shunt
5495	Incision of peritoneum
5551	Nephroureterectomy
5552	Nephrectomy of remaining kidney
5553	Removal of transplanted or regected kidney
5554	Bilateral nephrectomy
5561	Renal autotransplantation
5569	Ulcerative colitis, unspecified
557	Nephropexy
5583	Closure of other fistula of kidney

Postoperative Wound Dehiscence	
5584	Reduction of torsion of renal
5585	Symphysiotomy for horeshoe kidney
5586	Anastomosis of kidney
5587	Correction of ureteropelvic junction
5591	Decapsulation of kidney
5597	Implantation or replacement of mechanical kidney
5598	Removal of mechanical kidney
5651	Formation of cutaneous uretero-ileostomy
5652	Revision of cutaneous uretero-ileostomy
5661	Formation of other cutaneous ureterostomy
5662	Revision of other cutaneous ureterostomy
5671	Urinary diversion to intestine
5672	Revision of ureterointestinal anastomosis
5673	Nephrocystanastomosis, NOS
5674	Ureteroneoxystostomy
5675	Transureteroureterostomy
5683	Closure of ureterostomy
5684	Closure of other fistula of ureter
5685	Ureteropexy
5686	Removal of ligature from ureter
5689	Other repair of ureter
5695	Ligation of ureter
5771	Radical cystectomy
5779	Other total cystectomy
5782	Closure of cystostomy
5787	Reconstruction of urinary bladder
5900	Retroperitoneal dissection, NOS
5902	Other lysis of perirenal or periureteral adhesions
5909	Other incision of perirenal or periureteral tissue
6012	Open biopsy of prostate
6014	Open biopsy of seminal vesicles
6015	Biopsy of periprostatic tissue
603	Suprapubic prostatectomy
604	Retropubic prostatectomy
605	Radical prostatectomy
6061	Local excision of lesion of prostate
6072	Incision of seminal vesicle
6073	Excision of seminal vesicle
6079	Other operations on seminal vesicles
6093	Repair of prostate
6509	Other oophorectomy
6512	Other biopsy of ovary
6521	Marsupialization of ovarian cyst
6522	Wedge resection of ovary
6529	Other local excision or destruction of ovary
6539	Other unlilateral oophorectomy
6549	Other unilateral salpingoophorectomy
6551	Other removal of both ovaries at same operative episode
6552	Other removal of remaining ovary
6561	Other removal of both ovaries and tubes at same operative episode
6562	Other removal of remaining ovary and tube
6571	Other simple suture of ovary
6572	Other reimplantation of ovary
6573	Other salpingo oophoroplasty
6579	Other repair of ovary
6589	Other lysis of adhesions of ovary and fallopian tube
6592	Transplantation of ovary
6593	Manual rupture of ovarian cyst
6594	Ovarian denervation
6595	Release of torsion of ovary
6599	Other operations on ovary
6601	Salpingotomy

Postoperative Wound Dehiscence

6602 Salpingostomy
6631 Other bilateral ligation and crushing of fallopian tubes
6632 Other bilateral ligation and division of fallopian tubes
6639 Other bilateral destruction or occlusion of fallopian tubes
664 Total unilateral salpingectomy
6651 Removal of both fallopian tubes at same operative episode
6652 Removal of remaining fallopian tube
6661 Excision or destruction of lesion of fallopian tube
6662 Salpingectomy with removal of tubal pregnancy
6663 Bilateral partial salpingectomy, NOS
6669 Other partial salpingectomy
6671 Simple suture of fallopian tube
6672 Salpingo-oophorostomy
6673 Salpingo-salpingostomy
6674 Salpingo-uterostomy
6679 Other repair of fallopian tube
6692 Unilateral destruction or occlusion of fallopian tube
6697 Burying of fimbriae in uterine wall
680 Other incision and excision of uterus
6813 Open biopsy of uterus
6814 Open biopsy of uterine ligaments
683 Subtotal abdominal hysterectomy
684 Total abdominal hysterectomy
686 Radical abdominal hysterectomy
688 Pelvic evisceration
6922 Other uterine suspension
693 Paracervical uterine denervation
6941 Suture of laceration of uterus
6942 Closure of fistula of uterus
6949 Other repair of uterus

Accidental Puncture or Laceration

Numerator:

Discharges with ICD-9-CM code denoting accidental cut, puncture, perforation or laceration during a procedure in any secondary diagnosis field per 1,000 discharges.

Accidental Puncture or Laceration
ICD-9-CM diagnosis codes:

Accidental cut, puncture, perforation, or hemorrhage during medical care:
E8700 Surgical operation
E8701 Infusion or transfusion
E8702 Kidney dialysis or other perfusion
E8703 Injection or vaccination
E8704 Endoscopic examination
E8705 Aspiration of fluid or tissue, puncture, and catheterization
E8706 Heart catheterization
E8707 Administration of enema
E8708 Other specified medical care
E8709 Unspecified medical care

9982 Accidental puncture or laceration during a procedure

Denominator:

Accidental Puncture or Laceration

All medical and surgical discharges defined by specific DRGs (see denominators for **Complications of Anesthesia** for surgical discharges and **Decubitus Ulcer** for medical discharges).

Exclude:

Obstetrical patients in MDC 14 (Pregnancy, Childbirth and the Puerperium).

Transfusion Reaction

Numerator:

Discharges with ICD-9-CM codes for transfusion reaction in any secondary diagnosis field per 1,000 discharges.

Transfusion Reaction
ICD-9-CM diagnosis codes:

9996	ABO incompatibility reaction
9997	RH incompatibility reaction
E8760	Mismatched blood in transfusion

Denominator:

All medical and surgical discharges defined by specific DRGs (see denominators for **Complications of Anesthesia** for surgical discharges and **Decubitus Ulcer** for medical discharges).

Birth Trauma—Injury to Neonate

Numerator:

Discharges with ICD-9-CM codes for birth trauma in any diagnosis field per 1,000 liveborn births.

Birth Trauma
ICD-9-CM diagnosis codes:

7670	Subdural and cerebral hemorrhage (due to trauma or to intrapartum anoxia or hypoxia)
7673	Injuries to skeleton (excludes clavicle)
7674	Injury to spine and spinal cord
7677	Other cranial and peripheral nerve injuries
7678	Other specified birth trauma
7679	Birth trauma, unspecified

Denominator:

All liveborn infants.

Liveborn
DRGs:

385	Neonates, died or transferred to another acute care facility
386	Extreme Immaturity or respiratory distress syndrome of neonate
387	Prematurity with major problems
388	Prematurity without major problems

Birth Trauma—Injury to Neonate

389 Full term neonate with major problems
390 Neonate with other significant problems
391 Normal newborn

AND

ICD-9-CM diagnosis codes (includes 4th and 5th digits):

.

Admission type recorded as (4):

764 Slow fetal growth and fetal malnutrition
765 Disorders relating to short gestation and unspecified low birth weight
766 Disorders relating to long gestation and high birth weight
767 Birth trauma
768 Intrauterine hypoxia and birth asphyxia
769 Respiratory distress syndrome
770 Other respiratory conditions of fetus and newborn
771 Infections specific to the perinatal period
772 Fetal and neonatal hemorrhage
773 Hemolytic disease of fetus or newborn, due to isoimmunization
774 Other perinatal jaundice
775 Endocrine and metabolic disturbances specific to the fetus and newborn
776 Hematological disorders of fetus and newborn
777 Perinatal disorders of digestive system
778 Conditions involving the integument and temperature regulation of fetus and newborn
779 Other and ill-defined conditions originating in the perinatal period
V30 Single liveborn
V31 Twin, mate liveborn
V32 Twin, mate stillborn
V33 Twin, unspecified
V34 Other multiple, mates all liveborn
V35 Other multiple, mates all stillborn
V36 Other multiple, mates live- and stillborn
V37 Other multiple, unspecified
V39 Unspecified

Exclude:

Infants with a subdural or cerebral hemorrhage (subgroup of birth trauma coding - 7670) and any diagnosis code of pre-term infant (denoting a birth weight of less than 2,500 grams and less than 37 weeks gestation, or 34 weeks gestation or less).

Infants with injury to skeleton (7673, 7674) and any diagnosis code of osteogenesis imperfecta (75651).

Preterm infant

ICD-9-CM diagnosis codes:

76501 Extreme immaturity, less than 500 grams
76502 Extreme immaturity, 500 – 749 grams
76503 Extreme immaturity, 750 – 999 grams
76504 Extreme immaturity, 1000 – 1249 grams
76505 Extreme immaturity, 1250 – 1499 grams
76506 Extreme immaturity, 1500 – 1749 grams
76507 Extreme immaturity, 1750 – 1999 grams
76508 Extreme immaturity, 2000 – 2499 grams
76511 Other preterm infants, less than 500 grams
76512 Other preterm infants, 500 – 749 grams
76513 Other preterm infants, 750 – 999 grams
76514 Other preterm infants, 1000 – 1249 grams
76515 Other preterm infants, 1250 – 1499 grams
76516 Other preterm infants, 1500 – 1749 grams

Birth Trauma—Injury to Neonate

76517 Other preterm infants, 1750 – 1999 grams
76518 Other preterm infants, 2000 – 2499 grams
76521 Less than 24 completed weeks of gestation
76522 24 completed weeks of gestation
76523 25-26 completed weeks of gestation
76524 27-28 completed weeks of gestation
76525 29-30 completed weeks of gestation
76526 31-32 completed weeks of gestation
76527 33-34 completed weeks of gestation

Obstetric Trauma—Cesarean Delivery

Numerator:

Discharges with ICD-9-CM codes for obstetric trauma in any diagnosis or procedure field per 1,000 cesarean deliveries.

Obstetric Trauma
ICD-9-CM diagnosis codes:

66430,1,4 Trauma to perineum and vulva during delivery, fourth degree perineal laceration
66530,1,4 Other obstetrical trauma, laceration of cervix
66540,1,4 Other obstetrical trauma, high vaginal lacerations
66550,1,4 Other obstetrical trauma, other injury to pelvic organs

ICD-9-CM procedure codes:

7550 Repair of current obstetric lacerations of uterus
7551 Repair of current obstetric lacerations of cervix
7552 Repair of current obstetric lacerations of corpus uteri
7561 Repair of current obstetric laceration of bladder and urethra
7562 Repair of current obstetric laceration of rectum and sphincter ani

Denominator:

All cesarean delivery discharges.

Cesarean Delivery
DRGs:

370 Cesarean section with CC
371 Cesarean section without CC

Obstetric Trauma—Vaginal Delivery with Instrument

Numerator:

Discharges with ICD-9-CM codes for obstetric trauma in any diagnosis or procedure field per 1,000 instrument-assisted vaginal deliveries.

Obstetric Trauma
ICD-9-CM diagnosis codes:

66430,1,4 Trauma to perineum and vulva during delivery, fourth degree perineal laceration
66530,1,4 Other obstetrical trauma, laceration of cervix

Obstetric Trauma—Vaginal Delivery with Instrument

66540,1,4 Other obstetrical trauma, high vaginal lacerations
66550,1,4 Other obstetrical trauma, other injury to pelvic organs

ICD-9-CM procedure codes:

7550 Repair of current obstetric lacerations of uterus
7551 Repair of current obstetric lacerations of cervix
7552 Repair of current obstetric lacerations of corpus uteri
7561 Repair of current obstetric laceration of bladder and urethra
7562 Repair of current obstetric laceration of rectum and sphincter ani

Denominator:

All vaginal delivery discharges with any procedure code for instrument-assisted delivery.

Vaginal Delivery
DRGs:

372 Vaginal delivery with complicating diagnoses
373 Vaginal delivery without complicating diagnoses
374 Vaginal delivery with sterilization and/or D and C
375 Vaginal delivery with OR procedure except sterilization and/or D and C

Instrument-Assisted Delivery
ICD-9-CM procedure codes:

720 Low forceps operation
721 Low forceps operation with episiotomy
7221 Mid forceps operation with episiotomy
7229 Other mid forceps operation
7231 High forceps operation with episiotomy
7239 Other high forceps operation
724 Forceps rotation of fetal head
7251 Partial breech extraction with forceps to aftercoming head
7253 Total breech extraction with forceps to aftercoming head
726 Forceps application to aftercoming head
7271 Vacuum extraction with episiotomy
728 Other specified instrumental delivery
729 Unspecified instrumental delivery

Obstetric Trauma—Vaginal Delivery without Instrument

Numerator:

Discharges with ICD-9-CM codes for obstetric trauma in any diagnosis or procedure field per 1,000 vaginal deliveries without instrument assistance.

Obstetric Trauma
ICD-9-CM diagnosis codes:

66430,1,4 Trauma to perineum and vulva during delivery, fourth degree perineal laceration
66530,1,4 Other obstetrical trauma, laceration of cervix
66540,1,4 Other obstetrical trauma, high vaginal lacerations
66550,1,4 Other obstetrical trauma, other injury to pelvic organs

ICD-9-CM procedure codes:

Obstetric Trauma—Vaginal Delivery without Instrument

7550 Repair of current obstetric lacerations of uterus
7551 Repair of current obstetric lacerations of cervix
7552 Repair of current obstetric lacerations of corpus uteri
7561 Repair of current obstetric laceration of bladder and urethra
7562 Repair of current obstetric laceration of rectum and sphincter ani

Denominator:

All vaginal delivery discharge patients.

Vaginal Delivery
DRGs:

372 Vaginal delivery with complicating diagnoses
373 Vaginal delivery without complicating diagnoses
374 Vaginal delivery with sterilization and/or D and C
375 Vaginal delivery with OR procedure except sterilization and/or D and C

Exclude:

Instrument-assisted delivery.

Instrument-Assisted Delivery
ICD-9-CM procedure codes

720 Low forceps operation
721 Low forceps operation with episiotomy
7221 Mid forceps operation with episiotomy
7229 Other mid forceps operation
7231 High forceps operation with episiotomy
7239 Other high forceps operation
724 Forceps rotation of fetal head
7251 Partial breech extraction with forceps to aftercoming head
7253 Total breech extraction with forceps to aftercoming head
726 Forceps application to aftercoming head
7271 Vacuum extraction with episiotomy
728 Other specified instrumental delivery
729 Unspecified instrumental delivery

Appendix B: Detailed Methods

Empirical analyses were conducted to provide additional information about the indicators. These analyses were intended not as decision making tools, but rather explorations into the characteristics of the indicators. Specifically, these analyses explore the frequency and variation of the indicators, the potential bias, based on limited risk adjustment, and the relationship between indicators.

Analysis Approach

Data sources. The data sources used in the empirical analyses were the 1997 Florida State Inpatient Database (SID) (for initial testing and development; 1995-1997 used for persistence analysis) and the 1997 State Inpatient Databases (SID) for 19 HCUP participating States, referred to in this report as the National SID (for the final empirical analysis). The Florida SID consists of about 2 million discharges from over 200 hospitals, and was chosen because Florida is a large diverse State. The National SID consists of about 19 million discharges from over 2,300 hospitals. The National SID contains all-payer data on hospital inpatient stays from participating States (Arizona, California, Colorado, Connecticut, Florida, Illinois, Iowa, Kansas, Maryland, Massachusetts, Missouri, New Jersey, New York, Oregon, Pennsylvania, South Carolina, Tennessee, Washington, and Wisconsin). All discharges from participating States' community hospitals are included in the SID database, which defines community hospitals as non-Federal, short-term, general, and other specialty hospitals, excluding long-term hospitals and hospital units of long-term care institutions, psychiatric hospitals, and alcoholism and chemical dependency treatment facilities.

A complete description of the content of the SID, including details of the participating States' discharge abstracts, can be found on the Agency for Healthcare Research and Quality Web site (www.ahrq.gov/data/hcup/hcupsid.htm). Because the Florida SID was used only for initial testing and development, the empirical results reported are from the National SID. Descriptive results from the Florida SID are reported for comparison to ensure that the hospital-level results were similar in both data sources. Differences between Florida and national results are pointed out in the text. The National SID data were also used for the construction of area measures, with data from the U.S. Census Bureau used to construct the denominator of these rates.

Reported patient safety indicators. Three sets of patient safety indicators were examined. First, the Accepted patient safety indicators met the face validity criteria established through the literature review and clinician panel review. Second, the Experimental patient safety indicators did not meet those criteria, but appeared to warrant further testing and evaluation. Third, several Accepted patient safety indicators were modified into *area* indicators, which were designed to assess the total incidence of the adverse event within geographic areas. For example, the project team constructed an indicator for "Transfusion reaction" at both the hospital and area levels. Transfusion reactions that occur after discharge from a hospitalization would result in a readmission. The area-level indicator includes these cases, while the hospital level restricts the number of transfusion reactions to only those that occur during the same hospitalization that exposed the patient to this risk.

All potential indicators were examined empirically by developing and conducting statistical tests for precision, bias, and relatedness of indicators. For each indicator, the project team calculated five different estimates of hospital performance:

1. The raw indicator rate was calculated using the number of adverse events in the numerator divided by the number of discharges in the population at risk by hospital. For the area indicators, the denominator is the population of the Metropolitan Statistical Area (MSA), New England County Metropolitan Area (for the New England States) or county (for non-MSA areas) of the hospital.

2. The raw indicator was adjusted using a logistic regression to account for differences among hospitals (and areas) in demographics (specifically, age and gender). Age was modeled using a set of dummy variables to represent 10-year categories except for young children, whose age categories are

narrower (i.e., less than 1, 1-4, 5-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84, and 85 or more years), along with a parallel set of age-gender interactions. Because of sparse cells, certain age categories were combined or omitted for selected indicators, such as the obstetric indicators.

3. The raw indicator was adjusted to account for differences among hospitals in age, gender and modified DRG category (as described below).

4. The raw indicator was adjusted to account for differences among hospitals in age, gender, modified DRG, and comorbidities (defined using an adaptation of the AHRQ comorbidity software) of patients.

5. Multivariate signal extraction (MSX) methods were applied to adjust for reliability by estimating the amount of "noise" (i.e., variation due to random error) relative to the amount of "signal" (i.e., systematic variation in hospital performance or the 'reliability') for each indicator. This or similar "reliability adjustment" has been used in the literature for similar purposes.[125] [126] Mutlivariate methods (taking into account correlations among indicators to extract additional signal) were applied to most of the accepted indicators. The exceptions were Death in Low Mortality DRGs and Failure to Rescue. Only univariate signal extraction methods (smoothing) were applied to these two indicators and to the experimental indicators, because these indicators possibly cover broader clinical concepts. Correlations between these indicators and other indicators may not reflect correlations due to quality of care, and thus inclusion of these indicators may adversely affect the MSX approximations.

For additional details on the empirical methods, refer to the companion EPC HCUP Quality Indicator Report, published by AHRQ (http://www.ahrq.gov/data/hcup/qirefine.htm). Additional details on the modifications made to the DRG and comorbidity categories are described below.

Hospital Fixed Effects. In the risk-adjustment models, hospital fixed effects were calculated using the standard method with logistic models of first estimating the predicted value for each discharge, then subtracting the actual outcome from the predicted, and averaging the difference for each hospital to get the hospital fixed effect estimate. In the Quality Indicator Report,[127] linear regression models were used with hospital fixed effects included, arguing that the logistic approach yielded biased estimates due to the omission of a variable (the hospital) correlated with both the dependent (e.g., in-hospital mortality) and the independent (e.g., age, gender, APR-DRG) variables in the model. Given the rare occurrence of many of the PSIs, however, the logistic approach may be more appropriate for this application. Linear methods assume that the error term is normally distributed. This assumption is violated when the outcome is dichotomous.

The QI means were generally an order of magnitude higher than the PSI means, so the assumption was not as problematic. However, the most appropriate method depends on the particular characteristics of each indicator, whether QI or PSI. To the extent that bias is a concern, accounting for the clustering of patients by using a hospital fixed effect is advantageous. To the extent that extreme values are a concern, imposing structure on the error term with logistic methods is advantageous. In the end, the two approaches can be compared in terms of how much difference it makes in the relative assessment of provider performance. This issue warrants further analysis to better understand the trade-offs and limitations of each approach, and under what conditions and for what indicators each approach might best apply.

Specifically, the risk-adjusted "raw" estimate of a hospital's performance is constructed in two steps. In the first step, if it is denoted whether or not the event associated with a particular indicator Y^k (k=1,…,K) was observed for a particular patient i in year t (t=1,…,T), then the regression to construct a risk-adjusted "raw" estimate of a particular patient's performance on each indicator can be written as:

[125] Hofer TP, Hayward RA, Greenfield S, Wagner EH, Kaplan SH, Manning WG. The unreliability of individual physician "report cards" for assessing the costs and quality of care of a chronic disease JAMA 1999;28(22):2098-105.

[126] Christiansen CL, Morris CN. Improving the statistical approach to health care provider profiling. Ann Intern Med 1997;127(8 Pt 2):764-8).

[127] Davis et al. 2001.

(1) $Y^k_{it} = Z_{it}\ \Pi^k_t + \xi^k_{it}$, where

Y^k_{it} is the k^{th} PSI for patient i in year t (i.e., whether or not the event associated with the indicator occurred on that discharge).

Z_{it} is a vector of patient covariates for patient i in year t (i.e., the patient-level measures used as risk adjusters).

Π^k_t is a vector of parameters in each year t, giving the effect of each patient risk adjuster on indicator k (i.e., the magnitude of the risk adjustment associated with each patient measure).

ε^k_{it} is the unexplained residual in this patient-level model.

In the second step, the hospital effect was estimated by subtracting the resulting predictions from this patient-level regression from the actual observed patient-level outcomes, and taking the mean of this difference for each hospital. That is, for each hospital j (j=1,…,J),

(2) $M^k_{jt} = Y^k_{ijt} - (Z_{it}\ \Pi^k_t + \xi^k_{it})$, where

M^k_{jt} is the "raw" adjusted measure for indicator k for hospital j in year t (i.e., the hospital "fixed effect" in the patient-level regression).

Z_{it} is the vector of patient covariates for patient i in year t estimated in Step 1.

In addition to age, sex, and age*sex interactions as adjusters in the model, the project team also included a modified DRG and comorbidity category for the admission.

Modified DRG Categories. Two modifications were made to the Centers for Medicare and Medicaid Services (CMS, formerly Health Care Financing Administration) DRGs. First, adjacent DRG categories that were separated by the presence or absence of comorbidities or complications were collapsed. For example, DRGs 076 (Other Resp System Operating Room Procedures w CC) and 077 (Other Resp System Operating Room Procedures w/o CC) were grouped into one category. The purpose was to avoid adjusting for the complication the team was trying to measure. Second, most of the super-MDC DRG categories were excluded from the logistic models. Excluding these categories also avoids adjusting for the complications the team was trying to measure. For example, tracheostomies (DRG 482-483) often result from potentially preventable respiratory complications that require long-term mechanical ventilation. Similarly, operating room procedures unrelated to the principal diagnosis (DRG 468, 477) often result from potentially preventable complications that require surgical repair (i.e., fractures, lacerations).

In the companion technical report on quality indicators, the risk adjustment method implemented All Patient Refined (APR)-DRGs, a refinement of DRGs to capture different levels of complications. However, patient safety indicators, designed to detect potentially preventable complications, require a risk adjustment approach that does not inherently remove the differences between patients based on their complications. The APR-DRGs could be modified to remove applicable complications, on an indicator-by-indicator basis, but implementation of such an approach was beyond the scope of the current project. In this report, APR-DRG risk adjustment was not implemented.

Modified Comorbidity Software. To adjust for comorbidities, the project team used an updated adaptation of AHRQ Comorbidity Software (http://www.ahrq.gov/data/hcup/comorbid.htm). The ICD-9-CM codes used to define the comorbidity categories were modified to address four main issues.

1. Comorbidity categories were excluded in the current software that include conditions likely to represent potentially preventable complications in certain settings, such as after elective surgery. Specifically, three DRG categories (cardiac arrhythmia, coagulopathy, and fluid/electrolyte disorders) were removed from the comorbidity adjustment.

2. Most adaptations were designed to capture acute sequelae of chronic comorbidities, where both conditions are represented by a single ICD-9-CM code. For example, the definition of hypertension was broadened to include malignant hypertension, which usually arises in the setting of chronic hypertension. Unless these "acute on chronic" comorbidities are captured, some patients with especially severe comorbidities would be mislabeled as not having conditions of interest.

3. The comorbidity definitions did not include obstetric comorbidity codes, which are relevant for the obstetric indicators. Codes, when available, for these comorbidities in obstetric patients were added.

4. Slight updating was necessary based on recent ICD-9-CM code changes.

Low Mortality DRGs. In order to be included in the "Low Mortality DRG" indicator, the DRG had to have an overall in-hospital mortality rate (based on the National SID sample) of less than 0.5%. In addition, if a DRG category was split based on the presence of comorbidities or complications, then the category was included only if both DRGs (with and without comorbidities or complications) met the mortality threshold. Otherwise, the category was not included in the "Low mortality DRG" PSI. The indicator is reported as a single measure and stratified into medical (adult and pediatric), surgical (adult and pediatric), neonatal, obstetric and psychiatric DRGs.

Empirical Analysis Statistics

Using these methods, the project team constructed a set of statistical tests to examine precision, bias, and relatedness of indicators for all accepted hospital-level indicators, and precision and bias for all accepted area-level and experimental indicators. Each of the key statistical test results was summarized and explained in the overview section of the companion HCUP Quality Indicator report.[128] Tables B-1 through B-3 provide a summary of the statistical analyses and their interpretation.

Table B-1. Precision Tests

Measure	Statistic/Adjustments		Interpretation
Precision. Is most of the variation in an indicator at the level of the hospital? Do smoothed estimates of quality lead to more precise measures?			
a. Observed variation in indicator	Hospital-Level Standard Deviation Hospital -Level Skew Statistic	Unadjusted Age-gender adjusted Modified DRG adjusted Modified AHRQ comorbidity adjusted	Risk adjustment can either increase or decrease observed variation. If increase, then differences in patient characteristics mask provider differences. If decrease, then differences in patient characteristics account for provider differences.
b. MSX methods	Signal Standard Deviation Signal Share Signal Ratio	Reliability adjusted	Estimates what percentage of the observed variation between hospitals reflects systematic differences versus random noise. Signal share is a measure of how much of the total variation (patient and provider) is potentially subject to hospital control.

[128] Davies et al., 2001.

Table B-2. Bias Tests

Measure	Statistic	Interpretation
Bias. Does risk adjustment change our assessment of relative hospital performance, after accounting for reliability? Is the impact greatest among the best or worst performers, or overall? What is the magnitude of the change in performance?		
MSX methods: unadjusted vs. age, sex, modified DRG, comorbidity risk adjustment	Spearman Rank Correlation Coefficient (before and after risk adjustment)	Risk adjustment matters to the extent that it alters the assessment of relative hospital performance. This test determines the impact overall.
	Average absolute value of change relative to mean (after risk adjustment)	This test determines whether the absolute change in performance was large or small relative to the overall mean.
	Percentage of the top 10% of hospitals that remains the same (after risk adjustment)	This test measures the impact at the highest rates (in general, the worse performers).
	Percentage of the bottom 10% of hospitals that remains the same (after risk adjustment)	This test measures the impact at the lowest rates (in general, the better performers).
	Percentage of hospitals that move more than two deciles in rank (up or down) (after risk adjustment)	This test determines the magnitude of the relative changes.

Table B-3. Relatedness Tests

Measure	Statistic	Interpretation
3. Relatedness of indicators. Is the indicator related to other indicators in a way that makes clinical sense? Do methods that remove noise and bias make the relationship clearer?		
a. Correlation of indicator with other indicators	Spearman correlation coefficient	Are indicators correlated with other indicators in the direction one might expect?
b. Factor loadings of indicator	Factor loadings, based on Spearman correlation, Principal Component Analysis	Do indicators load on factors with other indicators that one might expect?